

Popular Mechanics

SEPTEMBER 1983

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A black and white photograph of a man with long, wavy hair playing a saxophone. He is looking down at the instrument with a focused expression. To his right, three packs of KOOL cigarettes are displayed: KOOL LIGHTS, KOOL ULTRA, and KOOL Filter Kings. The packs are white with green and gold accents. The background is dark, making the man and the cigarette packs stand out.

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Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

Ultra Kings, 2 mg. "tar", 0.2 mg. nicotine; Lights Kings, 9 mg. "tar", 0.7 mg. nicotine; Filter Kings, 17 mg. "tar", 1.1 mg. nicotine av. per cigarette, FTC Report Mar. '83.

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**Based on a comparison of base manufacturers' suggested retail prices. Levels of standard equipment vary.

†Savings based on manufacturers' suggested retail price of options listed if purchased separately.

Popular Mechanics®

VOLUME 160 NUMBER 3



ON THE COVER

After a tragic crash, the Thunderbirds, the Air Force's crack aerobatic team, are back again, thrilling air show crowds in new F-16 fighters. Read about their daring exploits in the story beginning on page 63.

—Photo by Terry Renna, James L. Long Assoc.

SEPTEMBER 1983

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POPULAR MECHANICS (ISSN 0032-4558) is published monthly by The Hearst Corporation, 224 West 57th Street, New York, N.Y. 10019, U.S.A. Subscription prices: United States and possessions, \$11.97 for one year, \$21.97 for two years. Canada and all other countries, add \$16.00 for each year. Second-class postage paid at New York, N.Y., and additional mailing offices. Authorized as second-class mail by the Post Office Department, Ottawa and for payment of postage in Canada, Registered as second-class matter at the Post Office at Mexico City, Mexico, June 20, 1950, No. 1983 by The Hearst Corporation. All rights reserved. Printed in U.S.A.



POSTMASTER: Please send address changes to Popular Mechanics, P.O. Box 10064, Des Moines, Iowa 50350.

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Editor-in-Chief: John A. Linkletter
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Special Publications: Clifford B. Hicks

Editorial offices: 224 West 57th St., New York, N.Y. 10019. We cannot be responsible for loss of unsolicited queries, manuscripts, or photos. For return, they must be accompanied by adequate postage.

Reader Service Department: Hilde vonThorak, director; 224 West 57th St., New York, N.Y. 10019; (212) 262-4292

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Chicago: 520 North Michigan Ave., Chicago, Ill. 60611; (312) 527-2400
Detroit: 377 Fisher Rd., Grosse Pointe, Mich. 48230; (313) 881-3520
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Published by The Hearst Corporation
President: Frank A. Bennack Jr.
Chairman: Randolph A. Hearst
President, Magazines Division: Gilbert C. Maurer
Publisher, Popular Mechanics: Daniel J. Coleman
Publishing Consultant: Richard E. Deems

POPULAR MECHANICS IS PUBLISHED MONTHLY by the Hearst Corporation, 959 Eighth Avenue, New York, N.Y. 10019. U.S.A. Frank A. Bennack Jr., President; Randolph A. Hearst, Chairman; Harrison A. Mitnick, Vice President and Treasurer; Harvey L. Lipton, Vice President and Secretary; Hearst Magazines Division: Gilbert C. Maurer, President; K. Robert Brink, Executive Vice President and General Manager; Raymond J. Petersen, Executive Vice President; Thomas J. Hughes, Vice President and Resident Controller; William S. Campbell, Vice President, Director of Circulation; Daniel J. Coleman, Vice President for Popular Mechanics.

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EDITOR'S NOTES

The add-on they built is called passive solar. But the word for the builders is *active*. It took action to get the room (page 91) ready in the short time we had to meet our photo deadline.

We personally would not try, nor even recommend, the flying ankle grip demonstrated by builders Fred Jewett and John Dunn Jr. However, they found it the quickest way to attach a fascia board when the normal ground-up approach was blocked by panes of glass set at an angle. The solar room is part of this month's 40-page *Home Energy Guide*. . . . **When the Air Force lost its four-man Thunderbird team** in a tragic crash in January 1982, there was some speculation whether a new performance flight team would be authorized and manned again. Well, the Thunderbirds are back—as our cover attests. And they're flying supersonic F-16s that will outperform the aircraft of just about any other flight team in the air. For a look at those daring pilots and how they fly, see page 63. . . . **Neil Shapiro, our electronics editor**, is the first person we know who has had a live-in robot. The kit-built Hero-1 balked at doing windows and floors, but he did take on a few night watchman chores. Neil's story (page 74) will help you decide whether you want the patter of little robot wheels around the house.



Adding a solar room: A job for circus aerialists?

The moon has been passing, periodically, between the earth and the sun for a much longer time than humans have been around to observe the result—an eclipse. But the prospect of a total concealment of the sun still sends hundreds of "eclipse watchers" to whatever part of the world it occurs.

PM joined the chase in June when Science Editor Dennis Eskow went to a soccer field in Indonesia to look at . . . well, really, darkness, and to photograph it for this issue. Darkness is indeed the result, as the pictures on page 51 prove. It was beastly hot there. Dennis reported in true foreign correspondent manner. But setting aside heat and other distractions, PM photographers exposed and processed 35-mm Polaroid slides even as the eclipse was under way.



Just before the eclipse, astronomer Krystyna Jaworowska and PM's Eskow set up.

As camera buffs will know, our photography is something of a first: first instant slides of an eclipse and first publication of such pictures.

John A. Littleton

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LETTERS TO THE EDITOR



After 40 years: Search for lost P-38s

In your June '83 *Letters* column (page 6), a reader commented on the six P-38 fighters and two B-17 bombers that ran out of fuel and had to belly-land on a Greenland icecap during World War II. He stated that no one has been able to recover the planes to this day.

Your readers might like to know that an expedition is now in Greenland to attempt their recovery. The 13-member team, sponsored by Winston cigarettes, is led by Russell Rajani, an airline pilot who located the approximate crash site last year.

The planes are believed to be buried under 40 feet of snow. If they can be recovered in reasonably good condition—as they were when they landed 40 years ago—they are estimated to be worth more than \$250,000 apiece.

DONALD A. YESKE
NORTH HIGHLANDS, CALIF.

I was very interested in your reference to the lost P-38s because, you see,

I was one of those P-38 pilots. After one of our group attempted a wheels-down landing and flipped, the rest of us were forced to land wheels up. The planes were not badly damaged, but, of course, could not be flown out.

We were stranded on the icecap for eight days until a dog sled team found us and led us out. We had to walk two days in 40-mph winds at 40° F. below zero to reach the east coast of Greenland. Four of those P-38 pilots are still living—Dallas Webb, Brad McManus, Carl Rudder and myself. I believe our mishap was one of the largest mass crash landings in history.

ROBERT B. WILSON, MAJ., USAF (RET.)
PINE, ARIZ.

Thank you both for your interesting sidelights on a little-known incident in WWII history. As of press time, there has been no word on how the recovery attempt is progressing, but it's expected to take all summer.

Helicopter high jinks

The perilous antics described in Ross Perot Jr.'s story *Around The World By Helicopter* (page 73, July '83) suggest that the *Spirit of Texas* should have been called the *Spirit of Adolescence*.

How many of those hapless sheep in Scotland expired after being chased by that aerial monster? How many airliners had to be diverted in India because the boys deliberately attempted to fake their position reports? If they had been imprisoned in Iran, would they have expected the U.S. government to start a war to get them out?

You called it an "aviation milestone." I call it another example of how rich kids with expensive toys engaging in reckless high jinks can further the image of the "ugly American" abroad.

B. FREER FREEMAN
ARLINGTON, VA.

We recognize that many readers may not approve of everything that occurred on the flight, but when a tiny, two-man helicopter circumnavigates the globe in less than 30 days, it's a newsworthy accomplishment.



A slick job: Mosaic-tiled countertop for a home bar made by PM reader Dan Jones.

Tile looks terrific

Your article *Tile Or Laminate Counter-top? Here's How To Do Both* (page 102, Feb. '83) was a great inspiration. After reading it, I built the party bar shown in the enclosed photograph (above).

I used mosaic tile and it came out looking terrific. It has added immensely to the value and appearance of our home. Thanks,

DAN JONES
INDIANAPOLIS

'Garageable' vans?

I enjoyed Mike Lamm's article *A Real Family Car: The Garageable Van* (page 66, June '83). The concept of a van that drives like a car is exciting, but I do have some reservations.

First, I don't think a four-cylinder engine is adequate for hauling heavy loads up steep grades or for safe passing on single-lane back roads. I'd like to see a six-cylinder engine, at least as an option. It would also provide the added muscle for such family-car amenities as air conditioning and electrically powered accessories.

I'd also like to see a different seating arrangement—two additional swivel bucket seats behind the driver and a bench that converts to a bed. Detroit is getting closer, but still doesn't have it all together yet.

LEWIS C. MARTIN JR.
OMAHA, NEB.

What does Lamm mean by "garageable"? He implies that standard vans aren't. Maybe out on the West Coast they have mini garages, but here in the East most garages have 7-foot doors that will accept even full-size vans.

HARRY C. WIERSDORFER
HAMBURG, N.Y.

Mike Lamm was using the term in the sense of meaning easily and conveniently garageable—not that full-size vans won't fit at all. In some garages, even those with adequate openings, there's not enough clearance to permit closing the doors or walking around the vehicle once it's inside.

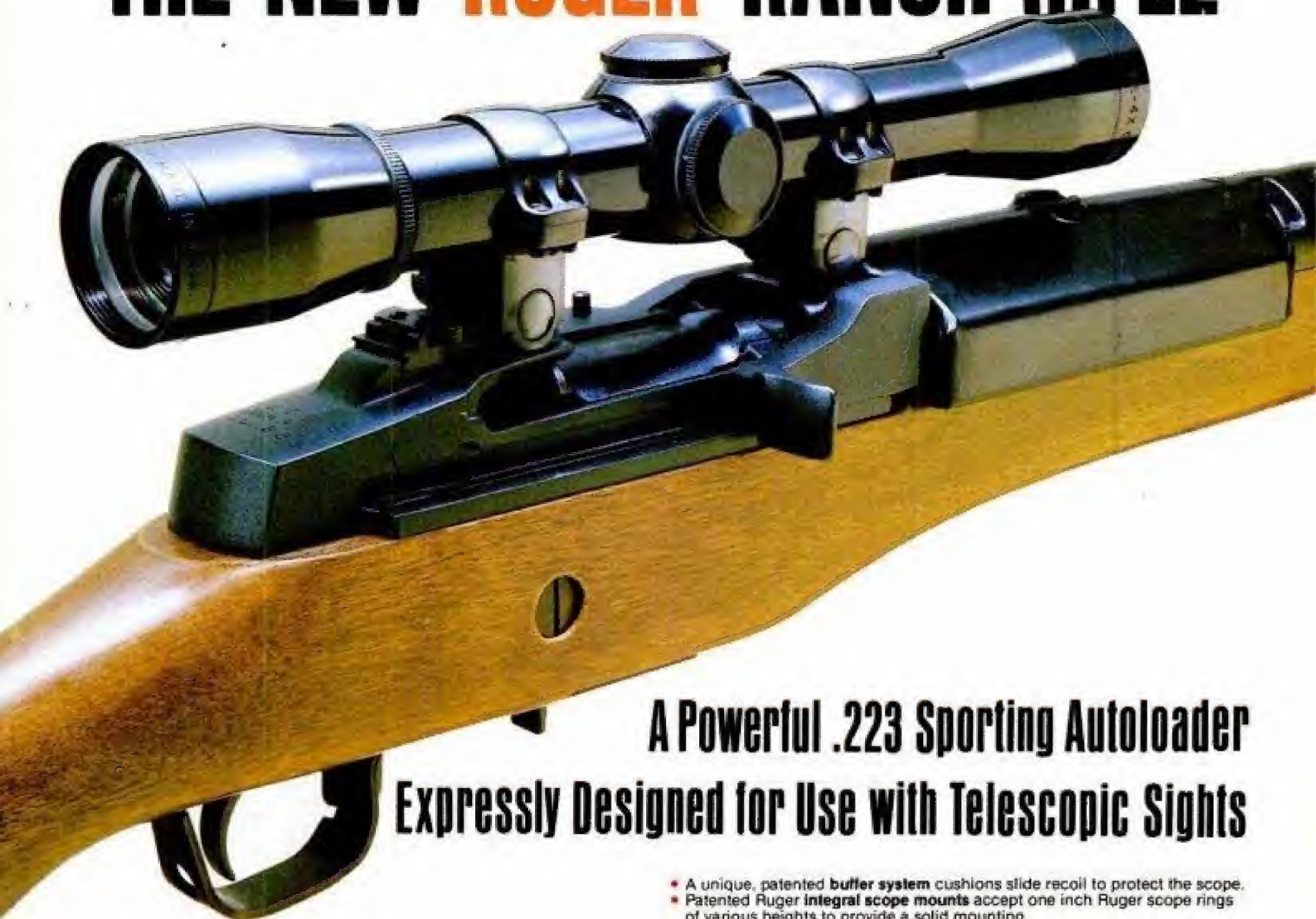
Down the tube-ing

In your May '83 *Car Care Guide* (page 168), you recommended the use of Norton's Tygon tubing for replacing rubber vacuum hoses in cars. This actually represents a misuse of our product.

Tygon tubing should not be used in under-hood automotive applications, as the high temperatures encountered will break down the material, causing it to harden, crack and eventually fail. For this reason, Norton urges your readers not to use Tygon in their cars.

JAMES D. PISULA JR.
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A Powerful .223 Sporting Autoloader Expressly Designed for Use with Telescopic Sights

Since its introduction, the .223 caliber Ruger Mini-14® rifle has achieved widespread acceptance as a rugged, compact sporting rifle — a scaled-down version of the U.S. Army Garand action. Now we offer the new Ruger *Ranch Rifle*® as an additional model in the Mini-14® line. The new *Ranch Rifle*® incorporates an ideal scope mounting system — integral scope bases in the receiver accept the proven solid steel Ruger mounting rings. The best mechanical features of the Mini-14® rifle have been retained, and some entirely new features added to achieve superlative performance:

- A unique, patented **buffer system** cushions slide recoil to protect the scope.
- Patented Ruger **integral scope mounts** accept one inch Ruger scope rings of various heights to provide a solid mounting.
- Modified **bolt stop** serves as an ejector in which empty cartridges are ejected **sideways** to clear the lowest mounted scopes.
- Tip-up **folding rear peep sight**, adjustable for windage, serves as a scope back-up.
- **Ventilated glass fibre handguard** protects the shooter's hand from barrel heat and moving slide.
- **American Hardwood stock** with molded **sporter-type buttplate** and polyurethane finish.

The effect of these changes is to make the *Ranch Rifle* the ideal .223 if you are going to use a telescopic sight. Ruger one inch mounting rings are included — a real performance package!



Technical Data:

Weight (Magazine empty, without scope or rings): 6.8 Lbs., **Length Overall**: 37.75", **Barrel Length**: 18.5", **Barrel Rifling**: 6 grooves, right hand twist, one turn in 10", **Trigger Pull**: 4.5 Lbs., **Maximum Range** (Approx.): 3,000 Yds., **Muzzle Velocity**: 3,300 F.P.S., **Muzzle Energy**: 1,330 Ft. Lbs., **Ammunition**: Standard U.S. Military or Commercial Caliber .223 (5.56mm) Cartridge.

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WRITE FOR A FREE COLOR CATALOG OF THE ENTIRE LINE OF FINE RUGER FIREARMS. SINGLE COPIES OF INSTRUCTION MANUALS FOR ALL MODELS OF RUGER FIREARMS ARE AVAILABLE ON REQUEST — PLEASE SPECIFY MODEL FOR WHICH YOU REQUIRE A MANUAL.

STURM, RUGER & Company, Inc.

53 Lacey Place

Southport, Connecticut 06490 U.S.A.

ALL RUGER FIREARMS ARE DESIGNED AND MANUFACTURED IN RUGER FACTORIES IN THE UNITED STATES OF AMERICA

A full-page advertisement for Marlboro cigarettes. The background is a photograph of two cowboys in a misty, grassy field. One cowboy, wearing a red shirt and a white cowboy hat, is mounted on a dark horse and is pulling a rope. The other cowboy, wearing a blue shirt and a white cowboy hat, is on the ground, also pulling the rope. The scene is atmospheric with a soft, hazy background. Overlaid on the bottom right of the image are two packs of Marlboro cigarettes: a red pack labeled 'Marlboro' and a gold pack labeled 'Marlboro 100's'.

Come to Marlboro

Marlboro Red or Longhorn 100's—
you get a lot to like.



Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

17 mg "tar," 1.1 mg nicotine av. per cigarette, FTC Report Mar.'83

A full-page photograph of a cowboy on a dark horse in a misty, mountainous landscape. The cowboy is wearing a tan vest, a light-colored long-sleeved shirt, and brown chaps. He is holding a white cowboy hat in his left hand. The horse is dark brown or black and is running or galloping through tall grass. The background is a soft-focus view of rolling hills and a body of water under a cloudy sky.

Country.

IMPORTS & MOTORSPORTS



Toyota minivan in showrooms soon

Next month, you'll have a choice of minivans. Toyota's 88-in. wheel-base Van Wagon is joining Chrysler's garageables, the Voyager and Caravan. Unlike the fwd Chrysler Corp. vehicles, the Van Wagon is rear-wheel drive, with the engine sitting behind the front axle. To find the two-liter, fuel-injected Four, just lift the driver's seat. That's where the powerplant hides. It's a 90-hp unit that delivers 25/31 mpg city/highway with the standard five-speed, which is about 1 mpg less than with the optional overdrive automatic transmission.

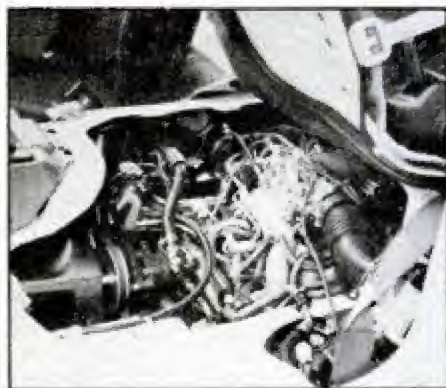


So round, so firm, so fully packable, Van Wagon will start around \$9,000.

We had a chance to put a few miles on one of the new vans and found it surprisingly roomy, quite comfortable and quick enough to satisfy most drivers. It also does a U-turn in a real tight 30.2 feet curb to curb.

Inside, you'll find that the van seats seven and the two rear benches come out for a maximum cargo capacity of 150 cu. ft. Base price should be about \$9,000, and Toyota has targeted an availability of about 3,000 vans a month for the United States.

The LE version—I call it the Luxurious Environment—comes with power steering, electric door locks and top-flight sound system. That's no big deal, but the list goes on: dual air conditioners, with separate controls front and rear, and six-pack-sized ice maker in the van's refrigeration system. Twin sunroofs top it all off.



Lifting driver's seat of minivan provides access to the two-liter, 90-hp Four.

Wheels over Texas

Yes, eight horses can get you airborne, and you thought that was barely enough for cutting the grass. This Briggs & Stratton-powered off-roader from California State University took the Mini-Baja race at the University of Texas this year.

Student racing teams qualified for engines donated by B&S. The vehicles they built were judged for creative design and safety, and tested on a four-hour endurance run. For part of the run, anyway, the winner's wheels were actually on the ground.



Off-roader powered by 8-hp Briggs & Stratton engine flies during Mini-Baja.

Getting to market

In industry lingo, we at PM are *product oriented*—intent on examining how cars and all manner of machines work and are used. But what consumers get and what price they pay are decided by *marketing people*.

For example, the two-way electric sunroof in the new Audi 5000S appears a bit of magic until you know what makes it tick: finding out is our kind of fun. But, that the sunroof is offered at all, and how it's priced (\$900!), is a marketing decision—a side of business we generally ignore.



Scoop! Fwd Toyota Corolla (and Chevy?).

However, it's hard to ignore the flap over the GM-Toyota plan to build a fwd Corolla and market it as a Chevette replacement. The deal needs government approval. Meanwhile, we product types are waiting to see if the little Camry-like car will be in the '85 Chevy lineup.

Ford Orion



Ford Orion is an Escort with a trunk.

Recognize this one? It's really not new. Just a notchback version of the world's best selling car—the Ford Escort, of course. The Orion was just launched in Europe, where its big boot (trunk, to us) is expected to appeal to "up-market" buyers.

Those marketing people really think they have a handle on our car-buying habits. Their statistics show that the shape of your (car's) behind is an accurate indication of your age. The older you are, the more likely you are to have a big trunk. By the way, I still own a hatchback.

PM



The original AudioLite Wall Switch.



The new AudioLite Wall Plug.

Tighten home security. Put ears on your lights.

Now the sound of your voice turns on your lights, your television, even your Jacuzzi. The original AudioLite Wall Switch brought you convenience and security straight from science fiction. Now the AudioLite Wall Plug gives you total portability with even more advanced crime deterrence.

Security that doesn't fall asleep.

Imagine an intruder prying open your door late at night. Suddenly bright lights come on and the snarls of a watchdog frighten him away. But you don't own a dog. You're not even home. The dog (tape re-

check. A light sensor automatically reduces sensitivity during noisier daytime hours.

Once activated, lamps or appliances remain on for the exact time duration you set—anywhere from 7 seconds to 7 minutes. Each new sound triggers the internal timer, beginning a new countdown. Lamps stay on while you're in a room and go off automatically when you leave, slashing your energy bills. (During quiet activities like reading, use the manual On-Off switch.) Of course, sound-emitting appliances like radios stay on until you turn

original AudioLite—the wall switch that turns on lights automatically when someone enters a room and turns them off when they leave. Cuts energy waste up to 50% in halls, bathrooms, closets, garages. Outdoors, the AudioLite Switch turns on your porch or driveway lights when anyone approaches.

Installation is simple. Use a screwdriver to replace your present wall switch. Nine-position dimmer gives you exactly the amount of light you need and extends bulb life up to 15 times. (Same timer, sensitivity controls as AudioLite Plug.) Works with up to 300 watts and in 3-way installations.

Proven solid-state reliability of the AudioLite Wall Switch now available in the Plug. UL approved. One year warranty.

Try one, or order a set.

A single AudioLite Plug (#MSM752) or Wall Switch (#MSM652) is \$34. But as soon as you try one, you'll think of many more places you can use them. That's why there's a special price of \$99 for a set of four. You can order 4 AudioLite Plugs (#MSM753), 4 Switches (#MSM653) or 2 of each (#MSM793). Order on trial—you must be satisfied or return your order within 30 days for a prompt refund.

Call for your set. Experience the magic and security of a home that responds to sound—with light.

ORDER TOLL FREE.

For fastest delivery, credit card holders may call our toll free lines. Please have the product number ready. Or send your check, adding delivery charge (2.50 for one, 4.50 for four). Calif. residents add 6% tax.

800 344-4444

Overseas/Canadian (415) 344-4444

THE SHARPER IMAGE®

406 Jackson Street, Dept. 8253
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© The Sharper Image

No wiring necessary. Simply plug the unit into your regular wall plug.

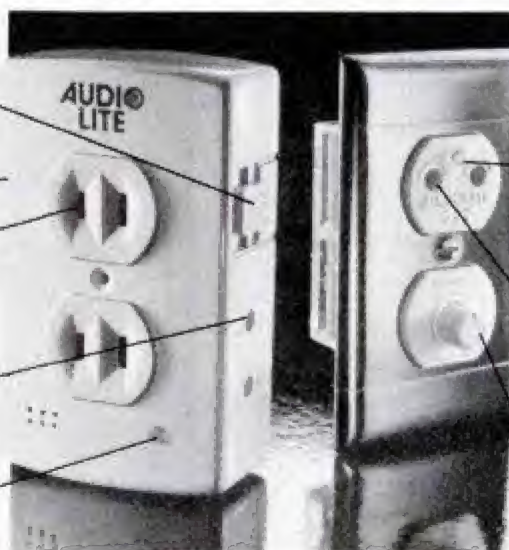
On-Off switch lets you operate lamps and appliances manually.

High-Low dimmer switch (on side) for convenience, energy savings.

Sound-activated socket operates lights, radios, appliances—any electrical device up to 300 watts. Bottom socket is unswitched for conventional use.

Timer control (7-second to 7-minute range). Controls are recessed to prevent tampering and accidental changing of settings.

Light flashes when plug "hears" a sound, making sensitivity easy to check and adjust.



Entire unit replaces your existing wall switch. Installation takes only minutes.

Light sensor reduces sensitivity during daytime when conditions are noisier.

Sensitivity control. You set precisely the sound level you want to trigger switch.

Sound turns on your lights automatically at any of 9 dimmer settings. On-Off positions permit manual control.

corded) and the lights were turned on by an ingenious sound-activated switch.

Use the AudioLite Plug anywhere—you just plug it into any AC outlet. Then plug a lamp or any appliance (up to 300 watts) into its top socket (the bottom socket is not sound-activated, allowing conventional use).

You set precisely the loudness of sound that triggers the unit—anything from a whisper to a loud command—so lamps only turn on when you want them to. Built-in indicator light flashes when unit "hears" a sound, making sensitivity easy to

them off. For even more energy savings, AudioLite Plug has a two-position dimmer for your lamps.

Now your home awaits your command.

The versatile AudioPlug will be a constant source of amazement. In the kitchen, a simple "good morning" turns on your coffemaker. In the living room, the sound of your slippered footsteps turns on lamps and soothing music. Your home is safe too. No more groping for a lamp in the dark, or risking injuries on dark stairs.

The original light switch with ears.

For wired-in convenience there's the

PM ELECTRONICS MONITOR



Little bitty bits

You might not think of storing important information in a hole—but that's just what researchers at Cornell University are doing. They are using something called "spectral holes" and storing up to 1,000 times more data than it's possible to store on a conventional laser disk.

Today's laser disk stores information in the form of spots burned in on the disk's surface by the recording laser. A laser beam can only be focused so thinly, so thus far it has been possible to store only 10,000,000 bits of informa-

tion in a square centimeter (a surprising figure in itself).

But now the Cornell group has found that they can tune their lasers to different frequencies. The tuned laser beams can be used to change the electrical state of special molecules rather than destroying them.

Once the molecules have changed state, when again hit with light at the frequency they were lasered, they vibrate. They will do so only for the frequencies they have been tuned for, and a molecule may have up to 1,000 fre-

quencies it will respond to. But to all other frequencies it is a "spectral hole" and will not respond.

This effect means that one laser-sized spot can now hold up to 1,000 different bits of information. Suddenly, we are no longer talking about 10,000,000 bits per square centimeter, but rather a truly mind-boggling figure of 100,000,000,000 bits in that same square centimeter.

Right now, the "spectral hole" storage is purely research. But it seems to hold absolutely immense promise for future developments. Information is more portable than ever before.

Portable player



Mister Disc (above) is a portable, battery-operated turntable. Complete with headphones, it lets you take LPs along.

The field of portable audio becomes bigger every day as more and more people put on their lightweight earphones and begin to live their life to the beat of a different drummer (or saxophonist). Latest is *Mister Disc* from Audio-Technica, which allows you to take records, rather than tapes, into the great outdoors.

However, be careful: *Mister Disc*, like any turntable, must be set on a relatively flat surface.

Computer U. teaches kids

This summer marked the beginning of a new educational experience for students from the ages of 8-17. Hundreds of kids settled in for a camp experience with computers.

Using the Apple IIe, the people at Computer U. made five-day sessions available (at \$95 per week) throughout

many areas of the nation to students wanting to learn about programming and how computers work. For many of the students, this was their first introduction to computing.

More and more public school systems are making computers available to their own students. And, legislation in Congress may someday make computers as visible as the blackboard throughout the nation's school system. But, right now, there are many more students eager to learn computers than

there are schools with the facilities to teach them.

For many people, places such as Computer U. may be the solution. Sessions will be continuing throughout the first weeks of September, so there may still be places available. Or, if not, plans may be made for next year.

Give the folks at the U, a call at (203) 871-6165 or you can write directly to the Computer Educational Institute, 281 Hartford Turnpike, Vernon, Conn. 06066.

PM



Information Via TV

Teletext and videotext are both ways to bring computer databases into a home on a TV, but they're quite different in concept. Teletext (shown above) broadcasts signals piggyback atop usual TV fare and is one-way. Videotext operates via phone lines or two-way TV cable.

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FREE \$29.95
LCD-Digital Watch



Specifications: HMR-20C
GAIN - 45 db
Frequency - 2.1-2.6 GHz
DISH SIZE - 20" full parabolic
TUNING - 55 thru 75 Mhz

Suggested retail price - \$325

Now as low as \$165

SELECT MARKETING, INC.
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NOW! GET COMMERCIAL-FREE TV IN YOUR HOME 24 HOURS A DAY.

Now in your own home you can receive the highest quality, most popular micro-wave receiver system in the country ... for only \$165.00.

You can watch 24-hour-per day movies, special sporting events and lots more, all on the TV set you are currently using!

It takes just minutes to install and then you can sit back, relax and enjoy all the great 24-hour programming month after month for free.

STATE-OF-THE-ART EQUIPMENT

This powerful HMR-20C microwave receiver system is designed to be installed within sixty miles of the microwave transmission station in your area (unobstructed line-of-sight) and comes complete with **all** the hardware: **60 FEET OF COAXIAL CABLE, CABLE ADAPTORS, POWER SUPPLY TUNER, INSTALLATION INSTRUCTIONS.**

We also offer our newest and most powerful antenna, the HMR-28C ... with 40% more power for the sharpest picture possible and the longest signal distance ... only \$220 complete including shipping and handling.

Both of these great antennas are tuneable through 44 frequencies, providing you with the greatest selection of programming available.

NO RISK GUARANTEE

Both units carry a 6-month limited warranty on defects in material or workmanship*. If you are unhappy with your unit for any reason, just mail it back within 30 days and receive your refund, no questions asked.

*All units returned for refund that are not defective are subject to a 15% restocking charge.

SPECIAL LIMITED OFFER

For a limited time only, you can receive, ABSOLUTELY FREE, a beautiful LCD 5-function digital watch with steel casing and lighted read-out. This watch is dustproof and is a \$29.95 value. Only one watch per family, please. Remember, a value like this can't last long, so place your orders today. Stock is limited to quantity on hand.

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Call today — our lines are open 24 hours a day, seven days a week. Our operators are waiting right now to take your order.

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We accept VISA or Mastercard or money order (allow two weeks for processing). If you prefer, personal checks are accepted (allow 4-6 weeks for processing).

QTY.	UNIT	Description	COST	TOTAL
	HMR-20C	Complete Unit	\$165.00	
	HMR-28C	Complete Unit	\$220.00	

California residents, add 6% Sales Tax _____

TOTAL _____

Remember, NO SHIPPING OR HANDLING CHARGE

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ADDRESS _____

CITY _____ STATE _____ ZIP _____

PHONE: am _____ pm _____

Please check one:

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SIGNATURE REQUIRED

EXP. DATE

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☐ Money Order (AMOUNT ENCLOSED) _____

☐ Personal Check (AMOUNT ENCLOSED) _____

ALL OUTDOORS



Handiest flashlight you'll ever own

Several years ago, I was rudely awakened by an angry man who poked a shotgun into my tent and told me I was camping on private land. Never one to argue with an irate man holding a weapon, I packed up my tent and walked about two miles to an area where I knew it was okay to camp.



StarDriver is great for pitching a tent at night. Its body is made of Lexan, so even dropping it on a rock won't damage it.

There was no moon, and by the time I got there rain had started falling. Ever try to pitch a tent in the rain when you can't even see your feet?

Boy, could I have used StarDriver.

StarDriver is a waterproof flashlight that weighs only six ounces. An optional headband lets you wear it around your head. Wherever your eyes look, that's where StarDriver's light points. It's great for pitching a tent, gathering wood, or doing any of the other things you may need to do during darkness in the woods.

In fact, StarDriver works well for any job in which you need three hands—one for the flashlight and two for the work. It's so handy, I don't know how I used to get along without it.

StarDriver costs \$19.95, and the headband is \$4.95.

It's sold by Early Winters Ltd., 110 Prefontaine Place S., Seattle, Wash. 98104-9977.

Scaled-down offshore racer

Been lying awake nights wishing you had a scaled-down version of the world's fastest offshore racing boat? Even if you haven't, you might still be interested in this 170-pound (without motor) Cougar Cub. The 10-foot fiberglass boat is a mathematical reduction of Cougar's 38-foot offshore racing boat, which at press time was the world's fastest offshore racing boat.

The little Cub doesn't have those credentials, of course. But it does plane easily with an outboard in the 15-to-

25-hp range. Standard equipment includes upholstery, lift rings, rack-and-pinion steering, rigging block, drain plugs and a vinyl rub rail. The price is \$1,795 (minus engine and throttle controls).

Early buyers of the boat include noted offshore racing personalities Bernie Little of *Michelob Light* fame and Peter Aitken of *Black Duck*.

For the name of the dealer nearest you, write Cougar Marine Inc., 2940 Northeast 188th St., North Miami Beach, Fla. 33180.



You can play like an offshore racer with Cougar's little Cub. Its small size and shape allow it to plane quite easily. It can carry two passengers comfortably.

Hot Pockits



Each Hot Pockits pad is perforated and can be separated into two small pads, so you can stick one in each pocket.

Here's an interesting item for warming your hands when they get cold outdoors. It's called Hot Pockits. Basically, Hot Pockits is a small, throwaway heating pad. To use it, you remove it from an airtight bag and squeeze it several times. This mixes its ingredients together (primarily cellulose and activated charcoal). The resulting oxidation process gives off heat (277 B.T.U.s) for several hours.

Each Hot Pockit is perforated and can be separated to make two small heating pads—one for each hand. Hot Pockits are \$3 each, or four for \$10. You can order them from HBC Enterprises, 98 Lakewood Drive, Congers, N.Y. 10920.

Windsurfing record set

There are easier ways to get from the Bahamas to Florida than on a sailboard. But Mickey Kerbel wasn't looking for an easy way. On April 30, at 7:00 a.m., Kerbel stepped onto his board at the Cat Cay Club in the Bahamas and headed for Key Biscayne, 50 miles west.

Unfortunately, a 15-knot wind was blowing out of the east, which made the entire trip downwind.

By 2:00 p.m., sailing on reaches, Kerbel had covered about 60 miles but had progressed only 20 miles toward Key Biscayne. Determined to make the crossing, Kerbel began sailing directly downwind, which, on a sailboard, requires a lot of muscle.

At 6:00 p.m. Kerbel sighted land. And two hours later he stepped ashore at Key Biscayne—the owner of a new world record. What does Kerbel do for a living? He owns a windsurfing shop, naturally.

FM



One can of Plasti-Kote brand



One can of typical 'bargain' paint

Who said all spray paints were created equal?

If you're from the 'I'll believe it when I see it' school, you just saw it. Plasti-Kote brand spray paint simply goes farther, lasts longer than the so-called bargain paints.

You get more coverage, and a tougher, longer-lasting finish with all Plasti-Kote paints. It stands to reason. We're the leader in automotive spray paints, where second-best finishes don't count.

Let's face it. The best part of painting is getting done. Get done faster, better, and stay done longer with Plasti-Kote. We make good paint. And that's the real bargain.



Left, no bargain in hiding power.

Right, Plasti-Kote makes painting jobs disappear a lot faster.

Left, no bargain in durability.

Right, Plasti-Kote's beautiful finish stands up to a lot more.



plasti-kote®

We go farther. We last longer.

1000 Lake Road, Medina, Ohio 44256

APPLIANCE CLINIC



Lazy dishwasher

We have a Signature five-cycle, two-level-wash dishwasher, model No. UCO96633A. We've had it for three years and it hasn't been used very often. The trouble is that it stops at rinse and stays there until we change it by hand. We'd appreciate any help you can give us.—Vincent Belletto Jr., Richwood, W. Va.

Sounds as if the timer is causing your problem. There may be a worn cam or possibly a defective switch contact inside the timer. If you want to repair the dishwasher yourself, order timer part No. S412301 from any Montgomery Ward service center near you. The

approximate cost of the timer is \$72.

To install the timer, unplug the dishwasher from its electrical source. Pull the timer knob off the front of the dishwasher. Then open the door.

Next, remove the six Phillips-head screws which hold the front panel to the inner door panel. Take off the front door panel. Now remove the four Phillips-head screws across the top of the door which hold the trim handle in place. Before attempting to remove the handle, pull off the two plastic end caps on either side of the handle. Roll off the handle toward yourself.

Once the handle is removed, the con-

trol panel can drop down. The timer will then be exposed, along with the selector switch. Remove the three screws which hold the timer bracket to the main control panel. With these screws removed, you can get at two other screws which hold the timer bracket to the timer.

Next, take the wires off of the spade terminals on the older timer. Install them on the new timer, one wire at a time. The terminals on the back of the timer are color-coded so they will correspond to the colors of the wires in the harness. Once the new timer is wired properly, you can reverse the disassembly procedure to put the dishwasher back in order.

Pump from vacuum cleaner

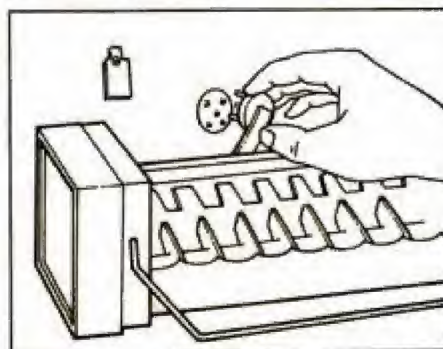
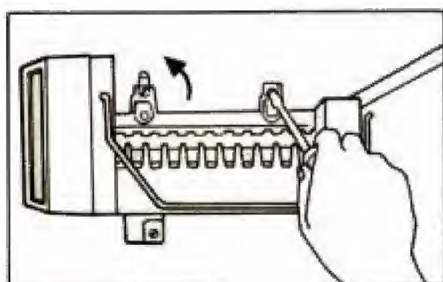
I have been doing some repair work on appliances in my spare time. I need specialized tools to work on refrigeration systems. I have a gauge set already, but now I need a vacuum pump, an item that is too expensive for a few casual jobs. Could you advise whether I can convert an old vacuum cleaner by using its motor to make a vacuum pump, or are there other appliances which can be used?—James Wong, Terrace, B.C.

The only thing I know of that will pump any kind of an adequate vacuum for a refrigeration system is a rotary vane vacuum pump intended for that purpose. If you need to use a vacuum pump only on occasion, look for a rental source in the classified directory under "Tools-Renting."

Flaky cubes

I have a Whirlpool refrigerator model No. EDT-191NKARO, serial No. S72137747. Ever since I bought the refrigerator in 1977, the ice maker has been putting small black flakes about the size of ground pepper into the cubes. Is there any way I can repair this permanently?—J.N. Cumbel, Canton, Ill.

It sounds like you need a mold kit installed in your ice maker. This is the assembly which contains the heater and the 12 slots where the water comes in. Apparently, the coating on



To remove the ice maker, loosen the top two screws and rotate the clips upward. Next, remove the bottom screw and bracket, then unplug the power cord.

the mold has broken down and the metal underneath it is flaking off.

My suggestion is to remove the ice maker. To do so, loosen the top two screws which hold the ice maker to the freezer liner, then rotate the clips up. Remove the bottom screw and bracket. Unplug the ice maker power cord from its socket. Take it to any Whirlpool authorized repair center and request

that the mold be replaced. The part for the mold kit is No. 833702, and it costs about \$30 plus labor to install.

Flooded dishwasher

I have a Montgomery Ward dishwasher, model UCO 929A, serial No. SBB 52330. The dishwasher goes through all of the cycles except the last one, leaving the washer full of water. I installed a new timer.—Robert C. Walton, Wheat Ridge, Colo.

Check for a partially clogged or restricted drain hose. Perhaps all of the water isn't leaving the tub fast enough during each drain cycle. To check the drain, first disconnect the electrical power to the machine (turn off the circuit breaker). Next, take off the lower service panel by removing the two screws at the bottom corners. Lift the panel to disengage it from the tub bracket. Now pull off the panel.

Locate the motor and pump assembly. Unscrew the clamp which holds the drain hose to the pump housing.

Remove the hose and try blowing through it. If there is blockage, you will have to disconnect the hose at the other end and clear the restriction with a coat hanger or a piece of wire. **PM**

If you have a problem with any appliance, send your question, along with the model and serial numbers, to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.

**At last—
you can own a
complete home workshop
that won't completely
fill up your home.**

Presenting the space-saving, money-saving Shopsmith® MARK V, the multi-purpose tool that gives you a complete home workshop in a single compact unit!

Use less space, get the five tools you need most

In no more space than a bicycle takes, the MARK V gives you the five power tools you need most.

It's a table saw, drill press, horizontal boring machine, lathe and disc sander — all in one economical package. The MARK V costs much less than you'd spend on these five individual tools. And you can actually do more with the MARK V!

**Precision's built in
so your projects
turn out right**

The MARK V lets you "share" features between tools to make them all more productive...more precise.

In fact, because most of the control you need for precision woodworking is built right into the MARK V, you should enjoy more successful projects. And less wasted time and materials.

One motor, one stand... lots of ways to expand

You'll save valuable workshop space with the MARK V thanks to all five tools sharing the same motor and stand. But that's just the beginning.

As your skills and needs grow, you can add more Shopsmith tools and accessories to your basic unit — with everything still running off the MARK V motor. Much cheaper than adding separate tools!



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Tools Built In The U.S.A

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To make your decision easier, we'll send you "How to Determine Your Best Power Tool Buy" — FREE! This fact-filled guide can help you find the right tools for your needs, abilities and budget.

...and we'll include the facts on the MARK V, too!

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CAR CLINIC



Clear water needed in Clearwater

I've been using a 100 percent concentration of Prestone II ethylene glycol antifreeze in my 1976 Chevrolet Nova 250-cu.-in. engine. Someone told me I shouldn't be doing this, but he couldn't explain why. Have I damaged my engine?—H.A. Watson, Clearwater, Fla.

Perhaps. Ethylene glycol needs water to reach a chemical balance that provides maximum corrosion protection. Straight doses may have allowed corrosion to gain a beachhead in the cooling system.

There are other factors—boiling point, for one. The boiling point for 100 percent ethylene glycol is about 180° F., while the boiling point of a 50/50

mixture of ethylene glycol and water in a cooling system under 14 pounds of pressure is about 250° F. In other words, you may be running your Chevy's engine at or close to the point of cooling-system boilover because you have been using 100 percent ethylene glycol.

Another reason for not using 100 percent ethylene glycol is that maximum freezing protection (about 50° F. below zero) is attained at a concentration of about 60 percent ethylene glycol and 40 percent water. Using more ethylene glycol will not reduce the freezing point further. So why spend money for more of a product that you don't need?

One story, two sides

My 1976 Volkswagen bus has developed a malfunction in the fuel-injection control unit. The owner's manual doesn't provide a wiring diagram. I called VW consumer service in San Antonio, Tex., and was informed that they won't supply the information I want—and that this electronic control unit can be repaired only by Robert Bosch.

I then called Bosch in Broadview, Ill. The technical representative flatly refused to supply a diagram and also said that Bosch wouldn't supply repair parts. Now, my only course of action is to exchange the entire unit for a rebuilt one which will cost me approximately \$200.

I have the electronics expertise to repair this unit if I can get the wiring diagram. This policy of VW and Bosch is grossly unfair and a rip-off. I guess I'm stuck and will have to pay \$200 for what could turn out to be something as cheap as a 39¢ transistor.—Merl F. Reed, Georgetown, Tex.

VW says it's all up to Bosch. According to a spokesman, VW technicians are automobile mechanics and not electrical experts. Faulty electronic control units brought to VW dealers are replaced with rebuilt units, and the bad units are then delivered to Bosch to be overhauled.

As for Bosch's explanation, a spokes-

man told me that wiring diagrams and repair parts are not supplied because of liability. The company fears that if you make an error in repairing the unit, it could lead to engine failure, fire or an accident. And Bosch, by appearing to condone do-it-yourself repair by supplying wiring diagrams and replacement parts, would be open to a lawsuit.

"We can't stop someone from rebuilding a unit, but we won't be a party to it," the Bosch spokesman said.

Octane shootout

Since the oil companies eliminated 93 R+M/2 fuel in my area, I've been using 91 R+M/2 in the 305-cu.-in. V8 engine of my 1978 Chevrolet Malibu (60,000 miles). But a knock has developed.

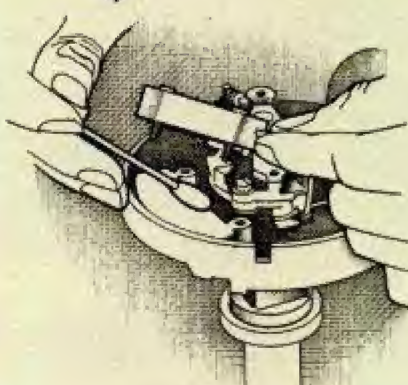
The owner's manual states that the engine should perform properly on 91 research octane fuel, which corresponds roughly to 87 R+M/2, so the engine is getting much more than called for. The knock occurs primarily when the car is driven up steep hills. The dealer has struck out in efforts to eliminate the problem. Do you have any suggestions?—Theodore J. Gerken, Ghent, N.Y.

If the manual says 87 R+M/2 is suitable and the engine knocks on 91 R+M/2, it's possible that a mechanical defect or out-of-spec condition exists. For instance, spark knock can result from the accumulation of carbon on the piston and combustion chamber. Before you try anything else, use GM top engine cleaner in the engine, following the directions on the can.

If that doesn't solve the problem, the knock could be the result of over-advanced ignition timing, high engine temperature, hot spots in the combustion chambers or on the sparkplugs, excessively lean fuel mix in one or more cylinders, excessive cylinder

(Please turn to page 22)

PM CAR CARE



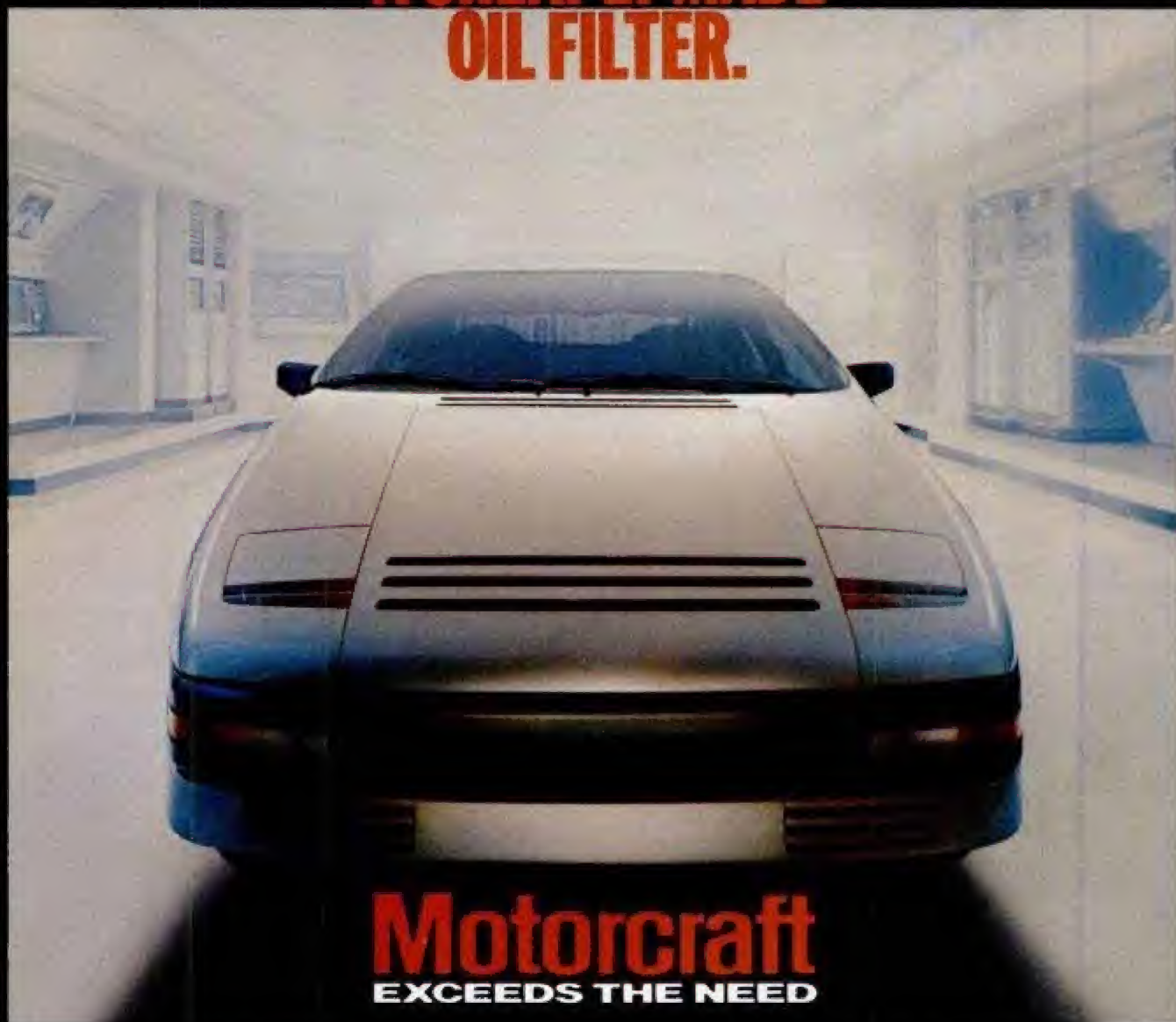
'Greasion' formula

Whenever you replace a control module in a GM HEI (High Energy Ignition) distributor, you should grease its backside. If you don't, corrosion can form on the module and cause an ignition-induced problem.

You shouldn't use just any grease. It has to be an electrical-conductive lubricant. You can buy such lubricants at a store that sells electronics supplies. General Motors recommends that you use GE Dielectric Heat Transfer Compound G642, Dow Corning Heat Sink Compound 341 or Dow Corning 5 Compound.

Apply the grease to the metal face on which the module rests and to the base of the distributor where the module is secured. This advice applies when you're installing a new module or if you're replacing a module following a repair.

YOU DON'T RUN MILLION-DOLLAR EXPERIMENTS WITH A CHEAPLY MADE OIL FILTER.



Motorcraft

EXCEEDS THE NEED

What existing oil filter could be selected for automobiles of such valuable technological stature?

Incredibly, many million-dollar experiments are guarded by a Motorcraft FL-1A filter — right off the shelf. Engineered to outperform all leading filters, the FL-1A's unique six-slot base accommodates oil flow rushes to nine gallons per minute. And an exclusive filter design incorporating a pleated filter element is blended with tough



man-made fiber. A superior material not found in cheaply made oil filters. The result?

Motorcraft FL-1A lasts longer and traps more abrasives than any other leading filter. So which would appear the better choice to protect your car? The Motorcraft filter proven in million-dollar experiments? Or one proven to trap less dirt for a shorter period of time? Motorcraft. Quality parts for all makes of cars. Get it together — buckle up.



CAR CLINIC

(Continued from page 20)

pressure, or a faulty emission control device.

Start by testing for an inoperative EGR valve and stuck or malfunctioning thermostatic air cleaner air-intake damper door, either of which can cause spark knock.

If both of these devices are in proper working order, check for excessive engine temperature. If you find the engine is operating at a temperature above the recommended range, clean and flush the cooling system and make sure the thermostat is operating properly.

Have a mechanic check for lean fuel mixture and vacuum leaks by checking HC emissions with the vehicle operating under load. He should watch for the intermittent spikes of HC that indicate lean misfire. White, blistered plugs also may mean an excessively lean mixture.

If the knock continues and the initial ignition timing is adjusted to the manufacturer's specification, check vacuum and centrifugal advance curves with a timing meter or an adjustable timing light. If timing is at the correct specifications at all engine speeds, retard the initial timing 2°.

You can safely retard timing a total of 6° from specification if necessary. But if you exceed that, there's danger of the exhaust valves getting too hot. Any timing retard will cause a loss of fuel economy and engine performance. Be sure to readjust curb and fast idling speeds if you change timing.

If knock persists, you might want to try installing sparkplugs that are one range colder than those recommended by the auto manufacturer. However,

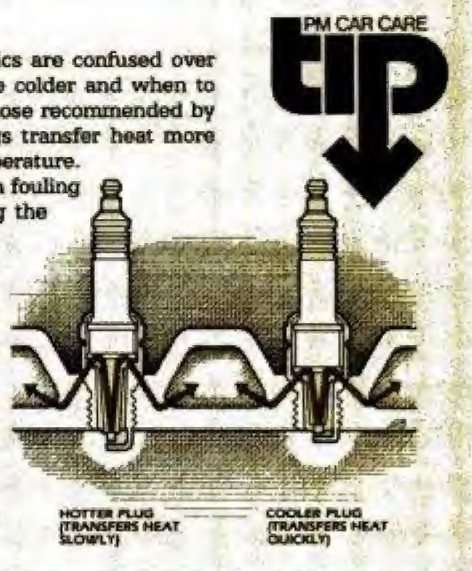
the colder plugs may cause driveability problems.

If all of the checks I have suggested fail to reveal the source of the spark knock, it's probably caused by excessive cylinder pressure. Excessive cylinder pressure is sometimes the result of mismatched or improperly machined engine components. Servicing warped cylinder heads (following head gasket failure) can also raise the cylinder pressure above specified levels.

Heat exchangers

It seems that some Saturday mechanics are confused over when to switch to sparkplugs that are colder and when to switch to plugs that are hotter than those recommended by the vehicle manufacturer. Hotter plugs transfer heat more slowly and operate at a higher temperature. They can help prevent sparkplugs from fouling if most of your driving involves idling the engine and operating in stop-and-go traffic. Colder plugs transfer heat more rapidly and operate at a cooler temperature. They can help prevent sparkplug overheating that leads to preignition in a vehicle that's driven continuously at high speeds.

Usually, switching to sparkplugs that are one step hotter or colder than the plugs recommended by the carmaker is sufficient. Plugs that are too hot or too cold will result in preignition or fouling, respectively.



Tinactin® for Athlete's Foot relief. We're fast on your feet.

Tinactin goes to work the minute it touches your foot. Starts immediately to kill the fungi that cause that itching, burning and soreness. Used as directed, Tinactin actually cures athlete's foot.

Get the remedy more doctors, pharmacists and podiatrists recommend than any other. Get Tinactin. And get rid of athlete's foot.

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LEADERS HAVE TASTE



Grenadiers reward the choosy smoker every way. Lean good looks. Rich aroma. Satisfying taste. A blend of five imported and domestic tobaccos, in light or dark natural wrapper, flavor-sealed in our Fresh Loc pack.

NATURAL LEAF WRAPPER

A&C GRENADIERS-THE TASTE LEADER

If you're left with a spark knock problem that you can't solve, you can increase the octane of gas by adding an octane extender (booster). These extenders are alcohol-based additives. All you have to do is pour the octane extender into the gas tank in a quantity not to exceed 10 percent of the fuel tank capacity.

For example, you can use up to 1 gallon of octane extender in 10 gallons of gas. This will increase the octane value of the gas by approximately three points.

Crying for attention

I have a 1981 Plymouth Reliant that has a four-speed manual transmission. I bought the car new after the 1982 models hit the market. A week after I took delivery, the transaxle started making a howling noise at 55 mph. There's also a whine in all gears at lower speeds.

The dealer says these noises are normal for a front-wheel-drive car. The car's been driven only 6,000 miles. What do you think I should do?—Joe N. Baum, Fort Lauderdale, Fla.

Howling and whining normal? Nuts to that. Have a dealer check alignment of the engine and transaxle. The assembly should be centered in the right and left mounts. If it isn't, the

engine-transaxle assembly needs to be shifted.

Also, look to see if the antiroll strut brackets are attached properly, especially the one on the front cross member. In 1981 models, in particular, some brackets were welded on an angle, causing the strut, which looks like a little shock absorber, to ground out and produce an rpm-related droning noise. If the antiroll strut bracket isn't straight, you should have it straightened.

If engine-transaxle alignment and antiroll strut brackets are okay, then the transaxle should be disassembled. Since you're on record as having complained about the problem from almost the first day of purchase, work should be covered under the terms of the warranty even if the 12 months or 12,000-mile period has lapsed.

If the dealer isn't cooperative, you should call Chrysler Corp. customer service in Orlando, Fla. The telephone number is printed in your Reliant's owner's manual.

FM

DO YOU HAVE A CAR PROBLEM?

Just ask Mort about it. Send your question to the Car Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. While letters cannot be answered individually, problems that are of general interest will be discussed in the column.

SERVICE TIPS

■ A 1983 Omni or Horizon with a 1.7-liter engine and air conditioning has a gold-colored relay on the left shock absorber tower that's supposed to engage the compressor for 5 to 10 seconds after you turn off the ignition. This puts a load on the engine to stop it from dieseling (running on). It seems that some wiring connections got turned around during production, and this is keeping relays in those cars from doing their job. If your car is running on, ask your dealer to check the relay wiring arrangement as spelled out in technical service bulletin (TSB) 24-01-83.

■ Lack of a 1-2 upshift when accelerating a 1981-83 Ford Escort or Mercury Lynx with automatic transmission may mean that the transmission needs new shift and modulator valves. These two valves are contained in a kit—Ford part No. E2FZ-7F417-A for 1981-82 models and No. E3FZ-7F417-A for 1983 models.

■ The alternator ground wire on 1981-83 Chevy Chevettes and Pontiac 1000s can break because of constant vibration-induced bending. You should secure the wire with a plastic clip (part No. 8900116). Attach the clip to the empty hole that is located between the 2 and 3 o'clock positions on the alternator end plate.

Inaugurating The Franklin Mint's
first series of precision die-cast models

The Mercedes 500 K Special Roadster



© 1983 F.M.P.M.

Shown smaller than actual size. Length approximately 8½".

Created under the direction of
America's most renowned automotive designer.

Conceived, engineered and built
to a new standard in automotive scale models.

FRANKLIN MINT  PRECISION MODELS

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GORDON M. BUEHRIG.
Designer of the legendary
Cord 810, the Duesenberg J,
the Auburn Speedster and,
now, Director of Franklin
Mint Precision Models. "I
was convinced that models
could deliver more—in
detail, finish, overall quality.
That's what separates this
model car from any you may
have seen before."

THE FIRST ISSUE of an important new series is traditionally of great interest to collectors—especially when that "first" involves collector model cars. For not only is model car collecting one of the most fascinating forms of collecting, but today it has also reached new heights of popularity the world over.

Now, The Franklin Mint is pleased to announce its first series of die-cast metal collector models: the great classic sports roadsters. Created under the direction of America's foremost automotive designer, Gordon M. Buehrig, it marks the initial issue of Franklin Mint Precision Models. And inaugurating this new collection will be an intricately detailed re-creation of the world-famous Mercedes-Benz 500 K.

Most people have never seen a model car of this quality

Introduced in 1934, the 500 K Special Roadster instantly became the talk of the Continent. Both for its advanced styling and its impressive performance—boosted by an on-demand, Roots-type supercharger that rocketed the car to speeds of more than 100 miles per hour.

And this exacting model has been created according to precise measurements and careful drawings taken from the original: an impeccably restored example, built in 1935, and recently named "Best in Class" and "Best in Show" at the famed Pebble Beach Concours d'Elegance.

The re-creation of this classic began as a sculptured prototype. With every curve, ev-

ery line, every feature painstakingly formed by a skilled modelmaker. This hand-made master was then carefully broken down—and used as the basis for tooling the more than 100 sets of steel dies needed for a truly detailed scale model.

Between these die-sets hot metal is injected to form fenders, hood panels, frame members. The spoked wheels and all trim-work are molded. Each part is inspected. Painted. And inspected again. Individually. All by hand. And finally the model is hand assembled—from more than 100 component parts, carefully fitted together to complete a single car.

This is model making raised to a standard of excellence never before available—except to those willing to incur the expense of commissioning a single-built example from a professional modeler for many hundreds, or even thousands, of dollars. Yet, the advanced engineering techniques of Franklin Mint Precision Models make it possible to provide this uncommon level of quality at \$90—which, in turn, is payable in three monthly installments of \$30 each.

A full range of operational features

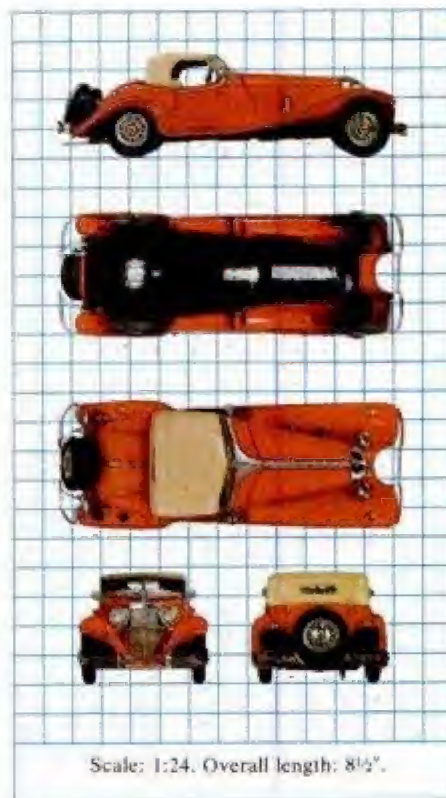
Crafted in the traditional scale of 1:24, The Mercedes 500 K Special Roadster is the perfect showpiece for a tabletop or desk—where you can examine and display its many operating features.

The steering is quick and precise. Hood, doors and trunk are hinged for opening. There is a dashboard with full instrumentation; floorboards covered with plush grey lining; and engine detailing that includes a Roots-type "blower," carburetor and ignition system.

All trimwork is authentic. Down to the hand-applied metal accent outlining the swept-back fenders. Thus, from the gleaming three-point Mercedes star on the radiator to the "knock-off" hub on the spares, this superb model will re-create the classic original—inside and out.

Available by direct application only

As an owner, you'll be able to display your 500 K with either the convertible "boot" or the top in place. You'll also receive a fascinating history of this classic touring car,



Scale: 1:24. Overall length: 8½".

complete with specifications and performance data.

If you are a car enthusiast—or a person who enjoys owning objects that are made with care and skill beyond the ordinary—this will be a most satisfying possession. One that friends, who share like interests, are certain to find equally intriguing.

The Mercedes 500 K Special Roadster will be crafted and imported exclusively by Franklin Mint Precision Models. It is available only by direct order and will not be sold in stores. No payment is required now. But, to be assured of earliest delivery, it is important to enter your order on the accompanying form by September 30, 1983.

ORDER FORM

Please mail by September 30, 1983

Franklin Mint Precision Models
Franklin Center, Pennsylvania 19091

Please enter my order for The Mercedes 500 K Special Roadster, precision crafted in die-cast metal, to be sent to me fully assembled and ready for display.

I need send no money now. I will be billed for my re-creation in three monthly installments of \$30,* each, beginning just before the car is ready for shipment.

and a total of \$3. for shipping and handling.

Signature _____

ALL ORDERS ARE SUBJECT TO ACCEPTANCE.

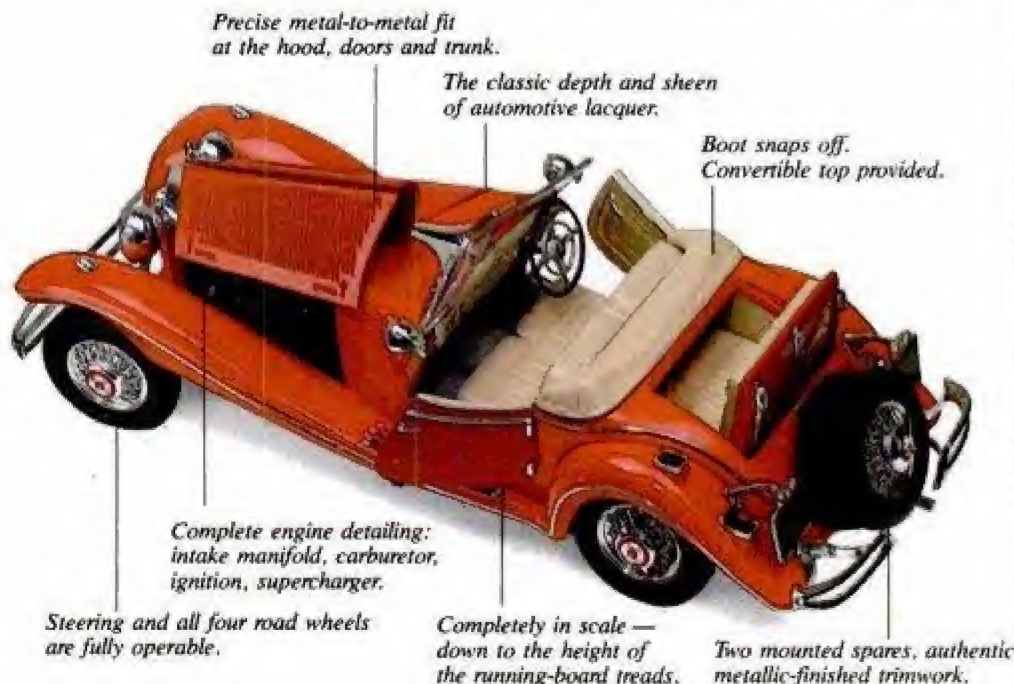
Mr. _____
Mrs. _____
Miss _____

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Address _____

City _____

State, Zip _____



Precise metal-to-metal fit
at the hood, doors and trunk.

The classic depth and sheen
of automotive lacquer.

Boot snaps off.
Convertible top provided.

Complete engine detailing:
intake manifold, carburetor,
ignition, supercharger.

Steering and all four road wheels
are fully operable.

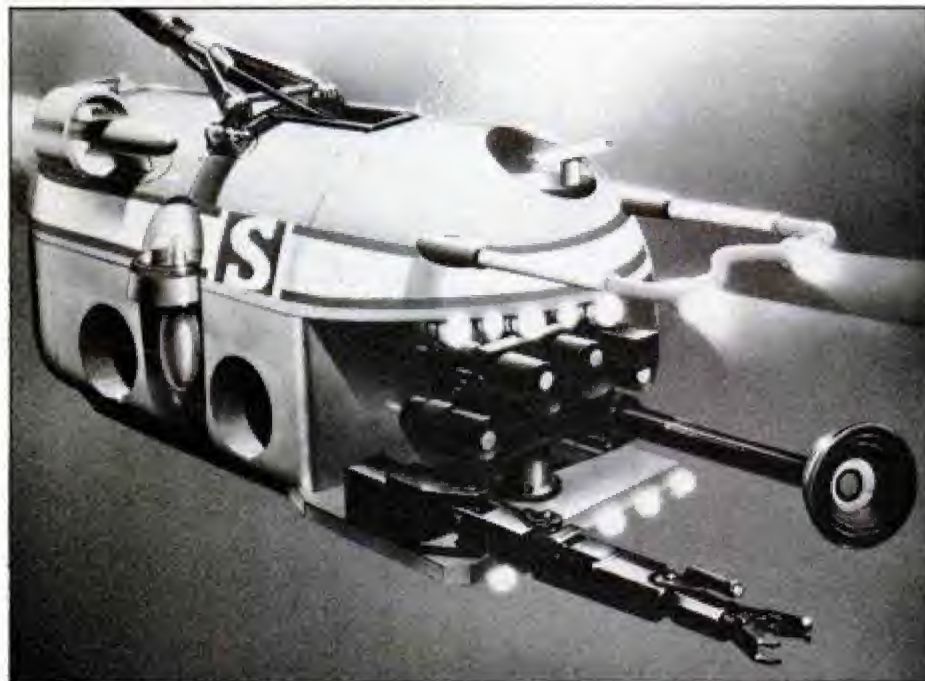
Completely in scale—
down to the height of
the running-board treads.

Two mounted spares, authentic
metallic-finished trimwork.

SCIENCE WORLDWIDE



SOLO takes a dive



Remote-controlled British submersible can televise at 7,500 feet below sea level.

British researchers later this year will take SOLO, a new remote-controlled submersible, beneath the North Sea for its first nonlaboratory runs. The glass-reinforced plastic hull vessel is designed to operate in heavy currents at 7,500 feet down. A pair of manipulator arms can lift heavy or tiny objects and can turn valves.

A pan and tilt video camera above

the sleek hull, and a color video camera that sticks out of SOLO's nose, give the vessel its vision. What it sees is carried to the surface by fiber-optic cables. With its extensive camera capabilities, especially the color feature, SOLO is expected to open new worlds for marine scientists and petroleum engineers who want to examine underwater structures.

Hands-off research

Everyone knows that X-rays help doctors diagnose bone fractures and malformations. But for some reason, most researchers looking for skull deformities in the babies of women taking anti-convulsive drugs made only visual inspections of the infants.

When QuynhChi Nguyenphuc of the Harvard School of Dental Medicine noticed that the researchers were finding far fewer deformities than could be expected, she ordered a dozen children X-rayed. Three of them turned out to have bone deformities.

The Harvard dentist says visual inspections were too subjective. The lab's accidental discovery will lead to

more widespread use of X-rays in future infant research.

No electric car this century

If Detroit ever mass-produces an electric car, it will be sometime in the next century, according to auto industry engineers who spoke at a Detroit symposium. The consensus is that battery technology remains underdeveloped. Batteries still in the nation's labs, including sodium-sulfur and lithium-metal types, may be the answer. But science first has to figure out how to safely dissipate the high temperatures, up to 932° F., generated by the research batteries.

Nuclear verification myths

One big snag in every nuclear arms treaty negotiation is verification—the ability to keep an eye on the other side to make sure they aren't cheating. At the recent Detroit meeting of the American Association for the Advancement of Science, several experts told me that verification technologies—satellites, electronic sensors, radar and seismographs—are less than 80 percent reliable, at best.

Stanford's Ted Ralston, a former Senate arms adviser, says some devices have reported nonexistent nuclear blasts, while others have missed explosions entirely. The scientists think negotiators should put less stock in verification in future arms talks.

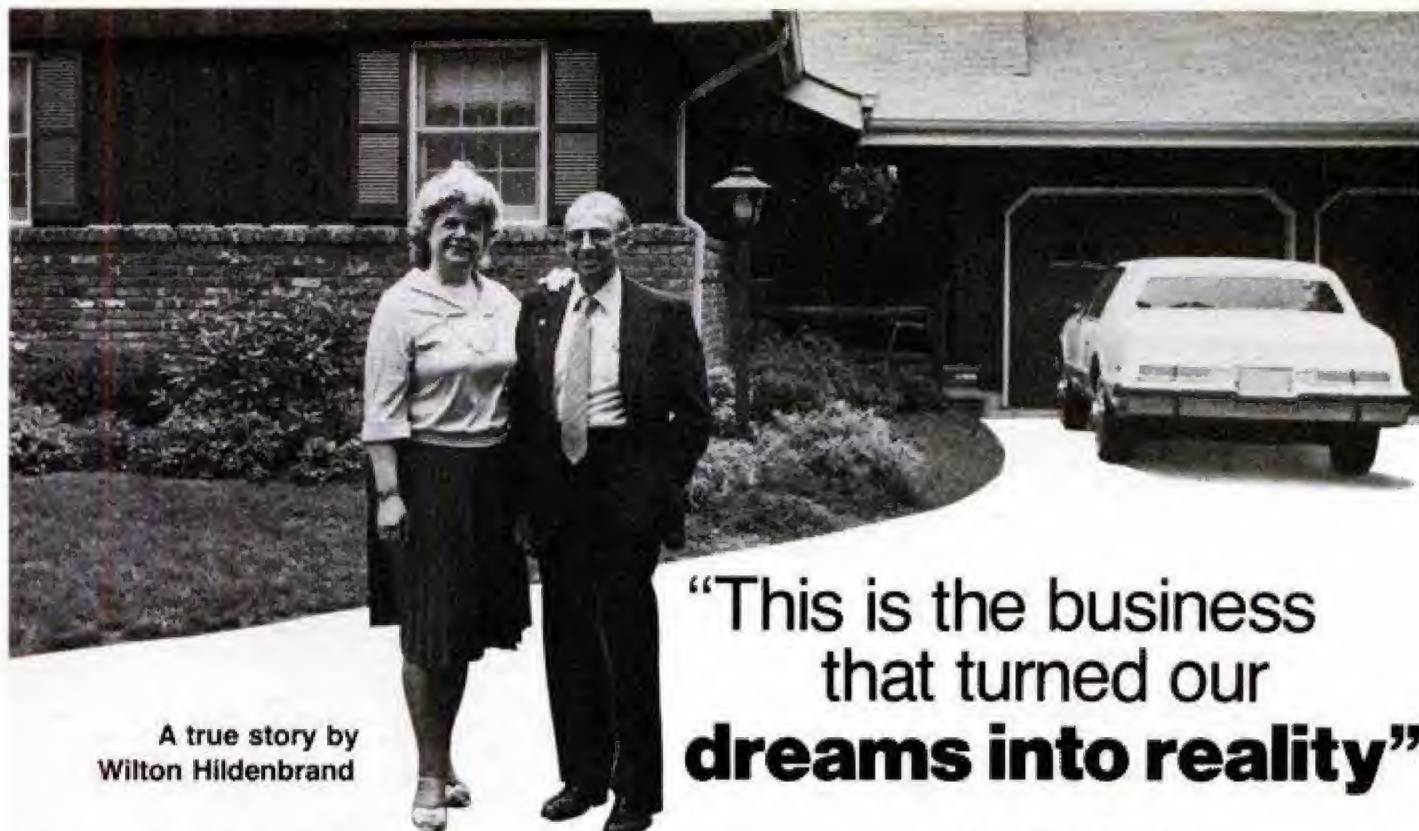
Stalking the macrophage

A large white cell in the human body, called a macrophage, is supposed to defend us by eating invading germs. But a Rockefeller University team says the cell may commit treason.

Early research reports indicate the macrophages sometimes act as nesting areas for invading germs that thrive on chemicals inside the white cell and reproduce faster than outside the cell. At a certain point, the white cell bursts and out come the growing elements of disease. The Rockefeller researchers spent part of the summer in Brazil studying lepers. The research may provide new leads on the curing of leprosy and other exotic diseases.

First factory in space

McDonnell Douglas and several corporate allies have launched three electrophoresis experiments on separate Space Shuttle missions. Electrophoresis is a process that separates molecules. It's used in genetic engineering and in the making of some medicines. The experiments were designed to find out whether the process could be carried out any better in space than on Earth. It can. McDonnell Douglas engineer David W. Richman says that 463 times more material can be separated in a weightless environment than on Earth. He says the companies hope to have a remote-controlled pharmaceutical factory in orbit by 1989. **FM**



A true story by
Wilton Hildenbrand

**"This is the business
that turned our
dreams into reality"**

I never made "real money" until I quit working for someone else and started my own Duraclean business

"When I was with the New York City Fire Department—with a wife, and three children to raise—I felt I spent most of my time putting out financial fires at home! It occurred to me that I could never achieve the financial security and independence we craved working for someone else. The obvious answer—start a business of our own. But what? Sure, we had been able to



put a little money aside, but nowhere near what it takes to start most businesses. I looked for something I could get into with a small amount of borrowed money.

So Easy to Get Started

"Marge, my wife, discovered the perfect answer. She had run across a Duraclean story—a message much like this one—and we looked into it. Well, believe me, when we saw the superior Duraclean service demonstrated and found out what a low investment it took, we were sold.

"With a fireman's schedule, I was able to start out in my spare time. (I didn't want to burn all my bridges behind me.) Marge and I mailed out company provided mailings describing our service and soon the phone began to ring. She made the appointments.

I rendered the service. When we discovered how much money there was to be made in a Duraclean dealership, I took early retirement from the fire department. Before long, I had to hire part-time servicemen. Soon, profits paid for our first van. Now most of the work is done by our four servicemen. Marge schedules the jobs, sends out mailings and does the bookkeeping. I do the job estimating, special spotting jobs and contact new prospects."

Now at this point you're probably asking yourself, what is this Duraclean business Wilt Hildenbrand keeps raving about? Well quite simply, it's a unique, superior system for cleaning upholstered furniture, rugs and carpets (don't confuse it with "steam cleaning" or ordinary shampooing methods). It not only cleans but restores and revives colors. It does not wear down the fiber or drive the dirt into the base of the rug as ordinary cleaning methods do. Instead it *lifts out* dirt by means of an absorbent dry foam.

Today the Hildenbrands provide cleaning for banks, country clubs, churches, offices, hotels, motels, funeral parlors, theaters and homes.

Carpet and furniture stores gladly recommend Duraclean to customers. It helps them close sales. 45% of the Hildenbrand's business is from customers' referrals and repeat orders.



Low Cost Investment

Would you like to have the freedom and independence enjoyed by the Hildenbrands? You can. Let us send you the facts. Mail the coupon, and you'll receive all the details, absolutely without obligation. No salesman will ever call on you. When you receive our illustrated booklet, you'll learn how we guide you STEP BY STEP to get customers; and how to convince your customers to recommend additional customers.

Wilton Hildenbrand mentioned the small amount of cash you need. Only \$5900 starts you in your own business. And, if you qualify, we have enough confidence in your success that we will finance the balance. The total cash investment is \$14,800.

Send for FREE booklet

Send in the coupon today. With no obligation, we'll mail you a 32-page booklet explaining the business. Then you, and you alone, in the privacy of your own home can decide. Don't delay. Get the facts while your service area is available. Mail the coupon now.

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Without obligation send free booklet that tells how I can have a Duraclean business. No salesman will call.

(PLEASE PRINT)

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Address _____

City _____

State _____ Zip _____

DETROIT LISTENING POST



Ohio Honda plant bears watching

Keenly aware of what happened to the VW Rabbit's image once it became domestically produced, Honda continues to soft-pedal its U.S. Accord's American assembly. The company's brand-new, million-square-foot plant in rural Marysville, Ohio, turned out its first four-door Accord last November. But its official dedication was delayed until everything was "just so." You don't entertain picky in-laws until your new house is ready.

Questioned about potential image problems at a press conference preceding the dedication, American Honda's senior vice-president answered: "We feel the best way to tackle that problem is to say as little as possible and let the car speak for itself." Based on the ones I've seen, it does.

At that time, the plant employed about 800 people building 185 cars per day on one shift. The eventual goal is 2,000 employees on two shifts and 600 cars per day (37.5 per hour), still slow and careful by U.S. standards. Home-built Hondas will be sold east of the Mississippi only, while Western-state cars will continue to be imported from Japan.

The plant is open, bright, cheerful, clean and papered with quality and



Bodies of Honda Accords meet drive trains on assembly line at Marysville, Ohio, plant.

team-spirit slogans thought up by the employees—"associates"—themselves. All associates, regardless of position, are dressed in white uniforms with green and white baseball caps. There are no executive bathrooms, dining rooms, or parking lots. And there aren't even any janitors. Associates

keep their own workspaces clean.

And there is no union. While we were being shown through the plant, I asked our associate guide about the UAW's notable absence. "That's up to the associates," she replied. "So far, the associates have chosen not to unionize."

Sports car wars heat up

Ford Mustang and Pontiac 2000 convertibles, the Dodge Shelby Charger, the new Corvette, Pontiac Turbo 2000, Ford Turbo EXP, Chrysler's Turbo Laser and Daytona, Pontiac's mid-engine Fiero and more for '84. Seems everyone's sports car crazy these days.

Looking ahead, Chrysler's working on a K-derived, two-seater soft-top with Mercedes styling, possibly for '85, plus a serious mid-engine GT with help from both Shelby and de Tomaso (who now heads up Maserati) for '87.

Both Buick and Cadillac Divs. are pushing GM for approval on luxury two-seaters, with the latter reportedly styled by Italy's Pininfarina, and Oldsmobile is considering its own exclusive 2+2. Rumor has Pininfarina also working up a convertible Cadillac Cimarón.

Looks like dull and boring is out and hot new stuff is in for the foreseeable future. Praise the Lord, drop the top and pass the map.

Social climbing by AMC/Renault

Looking beyond their successful Alliance, Jeep 4wds and French-built Fuego sport coupes, AMC and partner Renault say they're looking to compete in 50 percent of the U.S. market within the next five years compared to the 25 percent they cover today.

The new Alliance-derived Encore hatchback replaces the little LeCar at the bottom of the line this fall, while the aging Spirit and Concord models are discontinued.

That leaves ample room for expansion into the compact and mid-size ranges with both domestic and

imported family cars, sports models and luxury cars, in addition to a growing lineup of light trucks and utility vehicles.

One likely candidate for importation is a new \$12,000 Renault four-door hatchback that was recently introduced in Europe. But don't look for anything smaller than Encore in U.S. AMC/Renault showrooms for a while.

The littlest Chevy

The dubious distinction (at current gas prices) of having the smallest volume-produced car sold in the United States will pass to GM's Chevrolet Div. next spring when the tiny Suzuki-built mini arrives.

It will weigh just 1,500 pounds, measure 132 inches overall on an 88-inch wheelbase and reportedly cost a mere

(Please turn to page 30)



**FASTER THAN A FRIGHTENED WHITETAIL.
MORE POWERFUL THAN A RAGING GRIZZLY.
ABLE TO LEAP DEEP DITCHES IN A SINGLE BOUND.
TOO BAD IT WON'T START.**

Why put featherweight parts in a heavyweight machine? This hunting season look for this sign at participating stations, garages and NAPA stores. And keep your beast of a machine running super strong with tough NAPA parts. Or your hunting trip could come to a standstill.



Check Your Yellow Pages



\$4,500. Its three-cylinder engine will displace a Lilliputian 1.0-liter and should be able to better 60 mpg in the city.

Only 80,000 to 90,000 Chevy/Suzuki per year are planned vs. 200,000-plus each for the larger subcompact GM will import from Isuzu (also, supposedly, a 60-mpg car) and the jointly-built GM/Toyota, both to be marketed by Chevrolet and Pontiac Divs. How soon these state-of-the-art little cars, all fwd, will kill off the creaky old rear-

drive Chevy Chevette and Pontiac 1000 depends on buyer response.

New competitive spirit

It used to be that Detroit competed primarily with itself. Chevrolet concerned itself with beating Ford and vice-versa. Lincoln went after Cadillac, Dodge after Oldsmobile, and so on. For the most part, they couldn't have been less concerned about what the Europeans or Japanese were up to.

More recently, it's been "us" against "them," domestic vs. import. Now, it's every man for himself, each competing to be the industry's, the world's, best in every way. And this is by far the healthiest trend to appear in years, maybe ever.

Examples: The motoring press chides Chevrolet because its otherwise excellent V8 Camaro (165 hp with, 145 without cross-fire injection) can't compete with Ford's 177-hp 5.0 HO Mustang in brute acceleration. Chevrolet engineers launch Project Mustang to beat the upstart Ford with a new 190-hp HO engine, which hit the market last February. Now Ford, in response, is about to unveil a 200-hp V8 Mustang.

Chevy's new Corvette is hailed as the world's best-cornering production car. Ford's Special Vehicle Operations engineers pull out all the stops to out-corner it with their '84 SVO Mustang, hiring driving school operator and former frontline racer Bob Bondurant to do the test driving.

Chrysler chairman Lee Iacocca promises the domestic industry's first and fastest high-tech, four-cylinder turbocharged sports cars—the Chrysler Laser and Dodge Daytona. Ford and Pontiac rush to beat him with their own EXP and 2000 Turbos.

Pontiac aims to better the vaunted Porsche 944 in performance and handling with its ('85) V6-powered Fiero. Cadillac set its sights on the BMW 318i with Cimarron. And, finally, Lincoln draws a bead on the much more expensive Mercedes 380SLC and BMW 633CSi with its performance-model Mark VII LSC.

Everyone is striving to have the lowest-drag or highest-tech concept car. Everyone's trying for the best seats, the best engine computer, you name it.

Pick a plant, any plant, and its workers will tell you with absolute conviction that they're building the best cars, engines, radios, whatever. Detroit's newly awakened giants are even becoming serious about beating each other on the nation's race tracks once again.

This renewed, ultra-intense competitive spirit is good for the carmakers because it gets their creative juices flowing and gives them meaningful goals to work toward.

Once more, the auto industry has become an exciting place to work. It's good for us as consumers because it results in better products. And it's good for the country because it's doing wonders for our confidence and self image, not to mention the economy. Go for it, Detroit.

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HINTS FROM READERS

Removing greasy deposits



You can use paint remover to eliminate greasy encrustation that has built up over the years on skillets, stoves, machinery and other items. All removers do not work alike, however. Some require a longer time to soften the accumulation before it can be scraped off. Use a nonflammable remover if working indoors. Ventilate the work area and thoroughly remove all of the residue.—Walter E. Burton

Determining tap hole size

The formula outlined below determines the proper size hole to bore before tapping a thread, if you don't have a table handy. It applies to both fractional and numbered screw sizes.

First, determine the size and number of threads on a screw. As an example, we'll use a 1/4-in.-dia. x 20 thread-per-in. bolt.

Second, divide 1.3 by the number of threads to find the double depth of the thread. ($1.3 \div 20 = .065$).

Third, subtract the result from the bolt diameter (.250 - .065 = .185) to find the size drill bit to use for 100-percent thread depth. Generally, a hole of 100-percent thread depth can be bored where the depth of the hole being tapped does not exceed the tap diameter.

However, to arrive at the more conventional size drill bit for making a tap hole, find 25 percent of the double depth of the thread (.065 x .25 = .016) and subtract this from the double thread depth (.065 - .016 = .049).

Subtract this from the overall diameter (.250 - .049 = .201). Use this size bit to make a tap hole—G.R. Kern

PM PHOTO HINTS

Copyright stands



It's easy to fabricate a light stand for close-up or copy work. Use 1/2-in. particleboard (about 8 x 12") and pipe strapping for lamp support. A spring clamp may be used to attach the lamp.—A. Weber

Guardian angel



Protect yourself from a darkroom mistake by making a cover for the light switch. We show one made from metal strapping covered with black tape. For a final touch, the plate glows in the dark.—Neil Crichton

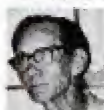
Film washer



Punch holes in a coffee can, add cord, drape over faucet and you have a film washer.—Louis Hochman

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Stylish electric food tray



Salton Inc., 1260 Zerega Ave., Bronx, N.Y. 10462, introduces the ET (electric tray) Hotray—the first transparent food warmer. The tray's tempered

safety glass warming surface keeps food hot without overcooking. The ET Hotray comes in two models: ET-3 (shown), \$55, and smaller ET-2, \$40.



Electric paint roller

The Wagner Power Roller combines spray-painting speed with paint-roller ease. A 45-w. motor moves paint through an 18-ft. hose to the roller. It's at paint and hardware stores for under \$100. For details, contact Wagner Spray Tech Corp., Box 9362, Minneapolis, Minn. 55440.

Lights, camera, action

Prestigeline Inc. offers a desktop version of the famous Hollywood Kleig lamp used to light motion picture sets. The Model 3301, shown, adjusts from 13 to 18 in. tall and is fitted with four



adjustable shades to direct the light as desired. Its list price is \$36. A smaller, clamp-on model is available for \$30. For more information, you should contact Prestigeline Inc., Box Q, 5 Inez Dr., Brentwood, N.Y. 11717.



One-cup coffeemaker

Here's an electric coffeemaker designed for the one-person household. It's the Melitta Model ACM-1A/1 (\$24.95). It brews one cup at a time and comes with 40 filters and a 12-oz. ceramic mug. It's made by Melitta Inc., Box 900, Cherry Hill, N.J. 08003.



Compact tractor

Mitsubishi offers an easy-to-operate tractor with four-wheel drive. Model MT180-HD (\$7,200) is powered by 18½-hp, water-cooled diesel engine with a hydrostatic transmission. For details, contact Sumitomo Corp., Mitsubishi Tractor Div., 345 Park Ave., New York, N.Y. 10022.

Vinyl wall coverings

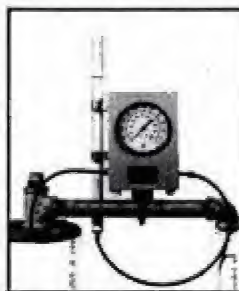
Wall-Tex Miniatures II vinyl wall coverings offer small-scale patterns in 141 color and pattern combinations. Shown here is the "Heidi" pattern. Prices range



from \$12.95 to \$17.95 per roll (35 sq. ft.). There are fabrics for drapes or slip-covers, too. By Columbus Coated Fabrics, 1280 North Grant Ave., Columbus, Ohio 43216.

Well water watcher

The Water Well Gauge (Model WG-100) tells the amount of water in any well and how many gallons per minute the well is producing. A 3½-in.-dia. dial shows how fast the water rises and how fast it's being pumped out. It costs about \$120, including the pump. From Hydrodyne, Box 519, Forestville, Calif. 95436.



Gunless caulk

UGL acrylic latex caulk is now available in 15-oz. aerosol containers, eliminating the need for a caulking gun. To apply, you press the flexible spout around windows and doors to seal out any drafts. It's available at hardware stores and home centers for \$4.95. The manufacturer is UGL, Box 70, Dept. PM, Scranton, Pa. 18501. **PM**





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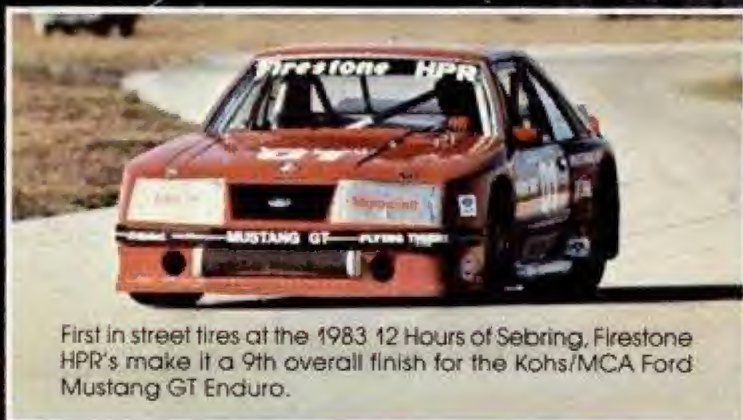
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At Sebring, the number one street tire for the second year in a row was Firestone's HPR® High Performance Radial. With International styling, stiff sidewalls for fast steering response, Aramid around steel belts for improved high speed performance, low profile 55 and 65 aspect ratios and wide block tread for increased traction, stability and handling. A top choice for your domestic or import car.

S-660 and HPR. Fire from Firestone. With red hot proof of performance for you. Both ready to go at your Firestone retailer.

Tires shaved to racing depth. Remember the safety of any tire depends on wear, load, proper inflation and driving conditions.

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Diagnosing Engine Compression Leaks

Have you ever been forced to live with a powerplant that just wouldn't idle smoothly, even after a tuneup and carburetor adjustment? Or how about that older, high-mileage engine that still runs reasonably well, but lacks the punch it once had and drinks fuel as though it had a hole in the gas tank?

In both cases the culprit very well may be poor sealing of cylinder pressure within the powerplant. A pressure leak is most likely to occur at the rings, the valves or the head gasket. But pressure can leak through cracks in cylinders or cylinder heads, as well. And, of course, severely damaged pistons or worn piston ring grooves (lands) will serve as escape routes for precious cylinder pressure.

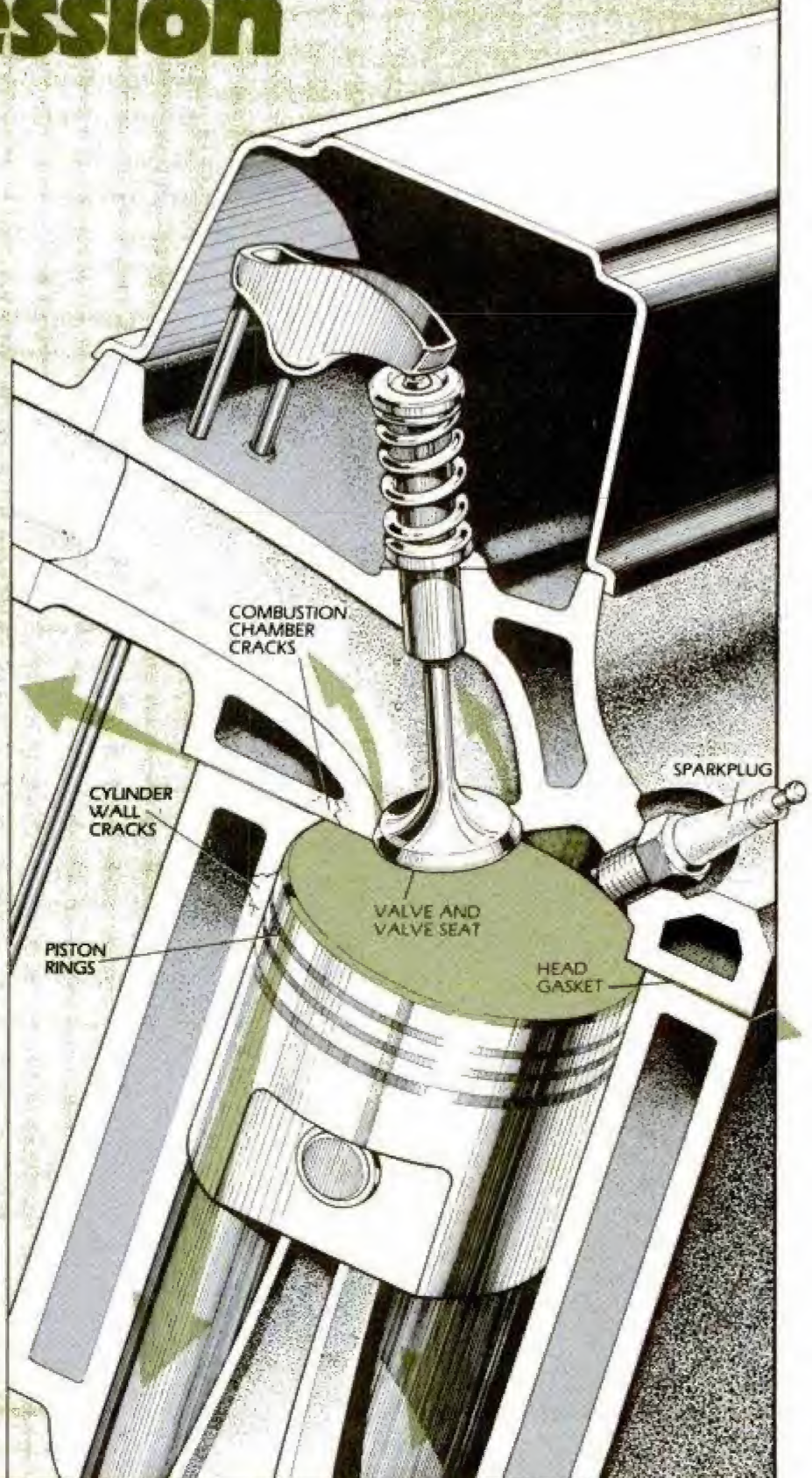
Correct cylinder pressure is essential to satisfactory vehicle operation. If an engine is unable to compress the air/fuel mixture as much as it should, the affected cylinder will not operate at maximum efficiency and the engine will lose power. And since a wider throttle opening will be required to propel the car at a given rate, more fuel will be consumed.

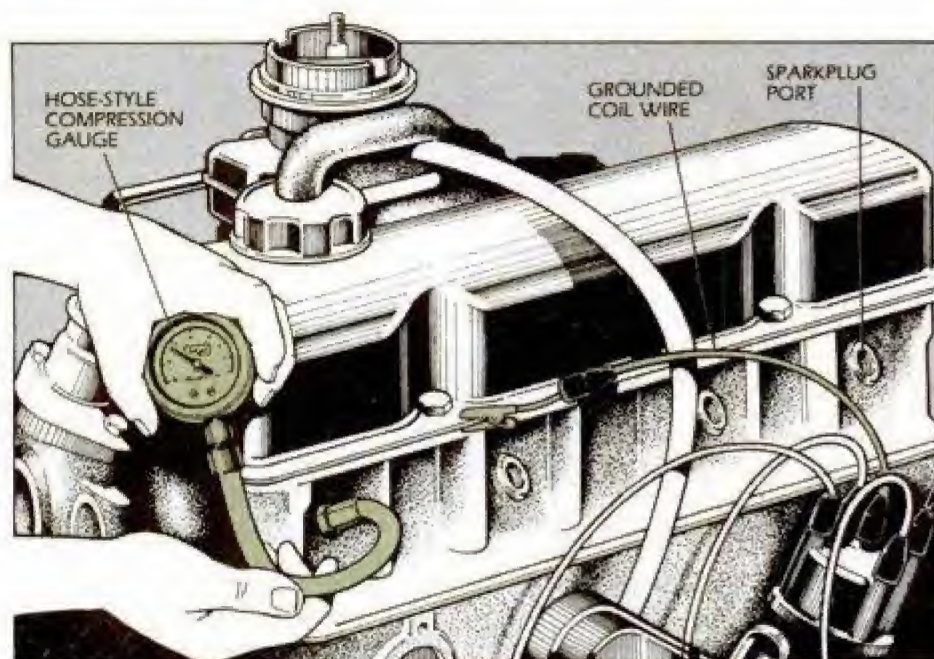
If only one or two cylinders have a defective compression seal, the engine will lope or miss while idling. If cylinder pressure is leaking through an intake valve, backfire may result at some speeds.

Check the ignition system

A check of ignition system components should always precede any attempts to diagnose an internal engine problem. This should include at least sparkplug cleaning, inspection and re-gapping, and a check of all secondary

Your engine's compression can leak past the valves, around sparkplug threads, past the piston rings, through cylinder wall or combustion-chamber cracks, or around the head gasket.





Most basic way of checking cylinder pressure is with a compression gauge, available in two basic types. Gauge attached to the plug port has a hose that screws into plug threads. Gauge at right has rubber nipple that's held against plug hole to get a reading.



components, including cap, wires and rotor.

Sparkplug condition can sometimes provide clues regarding internal engine condition.

Oily wet plugs with large deposits of carbon sometimes indicate defective piston rings, but the same condition can result from a number of other problems that are not related to ring sealing. Plugs that are slightly darker than others may indicate a poor compression seal, but again the same condition can be the result of various other problems.

If the internal problem is simply one of oil control, replacing or cleaning the plugs will probably make the engine perform better for awhile, but if the same plug fouls again within a couple of thousand miles, you can assume that a serious oiling problem exists.

Oil consumption problems are by no means always related to compression sealing problems, but a check of the compression seal should be performed when an oil consumption problem is noted.

Some mechanics check fuel system components before checking compression seal when a misfire or power loss problem arises. However, carburetor diagnosis is usually more difficult than internal engine diagnosis—unless you're equipped with an emissions analyzer—so the typical Saturday mechan-

ic will usually try to rule out compression seal problems as a cause of misfire or poor power before turning to the carburetor. (See *Saturday Mechanic: Troubleshooting Fuel System Problems*, page 35, Nov. '82.)

Checking cylinder pressure

The most basic method of checking for a compression leak is by measuring cranking cylinder pressure with a compression gauge.

Compression gauges are generally available in two basic types: One is fitted with a rubber nipple that is held against the plug hole to obtain a reading, while the other has a hose attachment that is screwed into the plug hole. The second type is easier to use, but with some care either can be used satisfactorily on most engines. On engines where access to the plug holes is limited, the hose type must be used.

Before beginning a compression test, remove all of the sparkplugs. If you don't have a remote starter switch that you can wire between the battery and starter relay or solenoid, you'll have to have a helper crank the engine from inside the car.

You have to make sure that your battery remains fully charged for the complete test, because compression readings will drop if the engine cranks noticeably slower. The best solution in this case is to perform the test while the

battery is connected to a charger.

Open the throttle valves and choke valve completely. You should provide some means of holding them open. The throttle can sometimes be held open by placing an appropriately sized object between the idle screw and fast idle cam. With the throttle all the way open, the choke unloader should push the choke part way open. You may need a piece of wire to hold it all the way open.

Disconnect the negative wire from the coil and cover the terminal end of it with insulating electrical tape. On GM HEI ignitions disconnect the BAT terminal from the distributor. Turn the key to the ON position, even if you're using a remote starter switch.

With the compression gauge in place on the first cylinder to be tested, crank the engine five times or until you get a maximum reading. Write down the gauge reading. Move on to the next cylinder and take a reading, cranking the engine the same number of times you did for the previous reading. Continue until all cylinders have been tested.

Interpreting gauge readings

All of your readings should be within 75 percent of your strongest cylinder. Furthermore, the pressure reading of each cylinder should equal the minimum suggested by the vehicle manufacturer. Minimum pressures are found in the spec tables of most general auto repair manuals.

With a small four-cylinder engine, however, you may want all of your cylinders to fall within 85 or 90 percent of each other. On a large V8, strong cylinders can compensate easily for their weaker brothers, but a small engine may suffer a considerable loss of performance and smoothness with a compression loss of 25 percent in one cylinder. It's all a matter of how fussy you are about the way your car runs, weighed against the cost of repairing the compression leak.

Locating leaks

The compression test won't tell you where the engine is leaking compression, just that a leak exists.

Mechanics used to squirt oil in the cylinders in an attempt to distinguish valve leaks from piston ring leaks, but this method will only reveal grossly leaking valves, because the oil volume raises the cylinder pressure and may therefore mask a slight valve leak. On the other hand, the oil may fail to seal seriously worn or damaged rings, causing you to conclude erroneously that the valves are the source of the prob-

lem. It can also mask a leaking head gasket.

The best method of pinpointing compression leaks is an air test, which can be performed with either a cylinder leakage tester or homemade air test device. The idea here is to pressurize each cylinder with compressed air and then look for the spot where it leaks out.

Performing an air test

A homemade air tester can be fashioned from an air hose, a regulator and a sparkplug hole/air hose adapter. This last item is threaded to fit the plug hole on one end and has an air hose connector on the other end. You should be able to purchase one at your local auto parts store. If your air compressor develops less than 90 p.s.i., you won't need the regulator.

A commercial cylinder leakage tester will provide more than just an indication of where the leak is located. It will also tell you what percent of the compressed air charge is leaking out of the cylinder. This can help you determine how serious the leak is.

The cylinder leakage tester offers another advantage. If your engine has a bad compression ring seal and an internal oiling problem (the two don't necessarily go together), a cranking compression test may fail to reveal a poor compression seal due to the presence of oil in the cylinder.

In this case, the cylinder leakage tester can help you diagnose a compression leak, because it is not as easily fooled by the presence of oil in the cylinder as the compression gauge. However, the homemade air tester cannot measure the seriousness of a compression leak. All it can do is locate it.

Determining TDC

The air leak or cylinder leakage test must be performed while the cylinder being tested is at top dead center on its compression stroke. There are several ways to determine TDC.

The crankshaft pulley or flywheel of your engine is marked for No. 1-cylinder TDC. If the No. 1 cylinder is on compression stroke, the distributor's rotor should be pointing to the No. 1 plug wire. (Check a manual if you don't know how the cylinders of your V8 engine are numbered. Nearly all four and six cylinders are numbered front to rear.)

If you have good access to the crank pulley, you can mark it for top dead

center of the other cylinders. TDC of an eight cylinder occurs every 90°. TDC of a four cylinder occurs every 180°.

If you have a six-cylinder engine, TDC occurs every 120°. A flexible tape measure can be used to measure the circumference of the pulley. The circumference is then divided by half the number of cylinders, and the pulley is marked in increments of a length equal to the quotient.

For example, on a six-cylinder's pulley, measuring 18 inches in circumference, the TDC marks would occur every six inches. One mark is already there. You would make two additional marks.

Assuming that the firing order is 153624, the mark that you make 120° counterclockwise will be TDC, cylinder 5. The second mark that occurs as you continue to rotate the engine clockwise will be TDC, cylinder 3. On the engine's next clockwise rotation, the original TDC mark will be for cylinder 6. The second mark will be TDC/2, the last mark TDC/4.

Another method is to use some type of device to signal you as each cylinder rises to the top.

Some mechanics use a whistle which has been inserted into the end of a hose that is attached to one of those previously mentioned plug-hole/air hose adapters. When the contraption is screwed into the plug hole and the engine is turned, the whistle will shriek

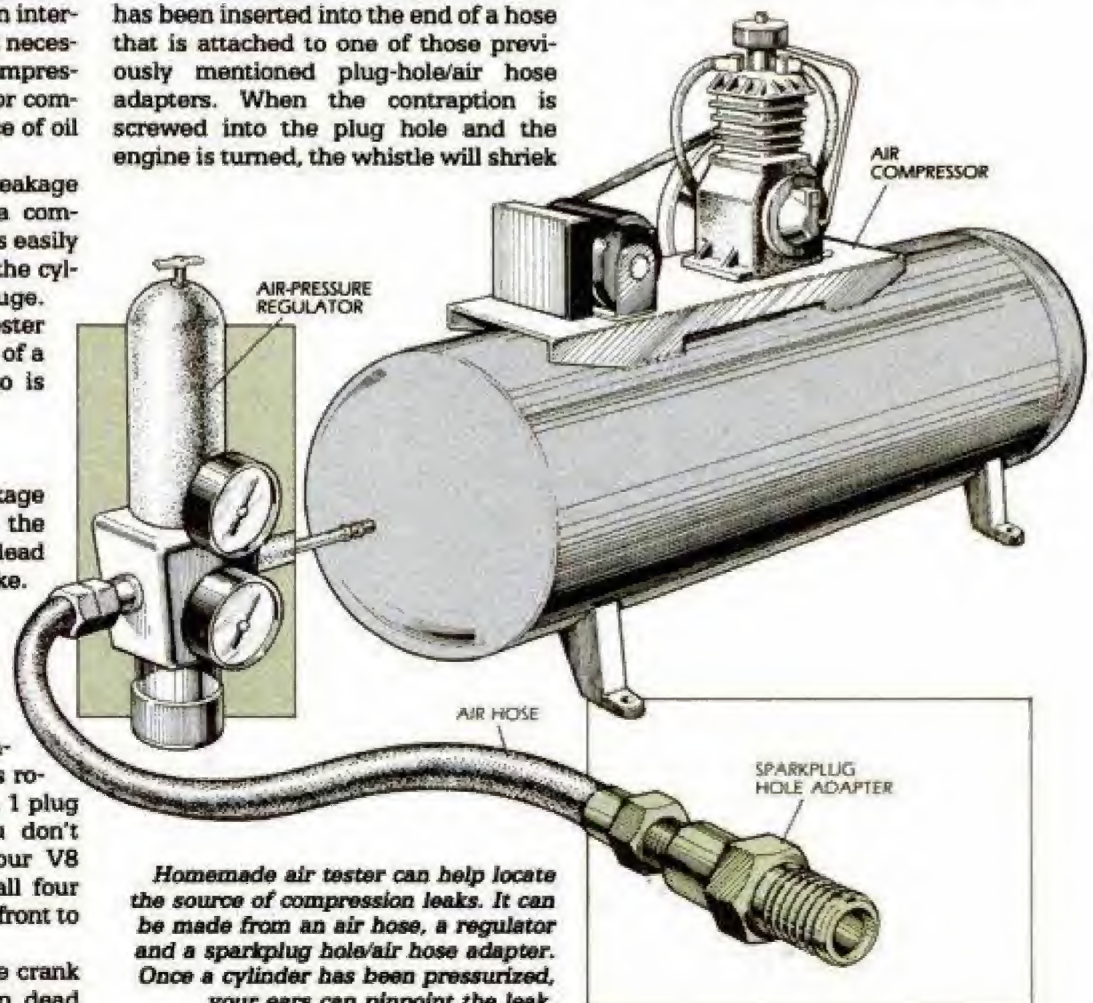
loudly on the compression stroke, but will stop abruptly as TDC is reached.

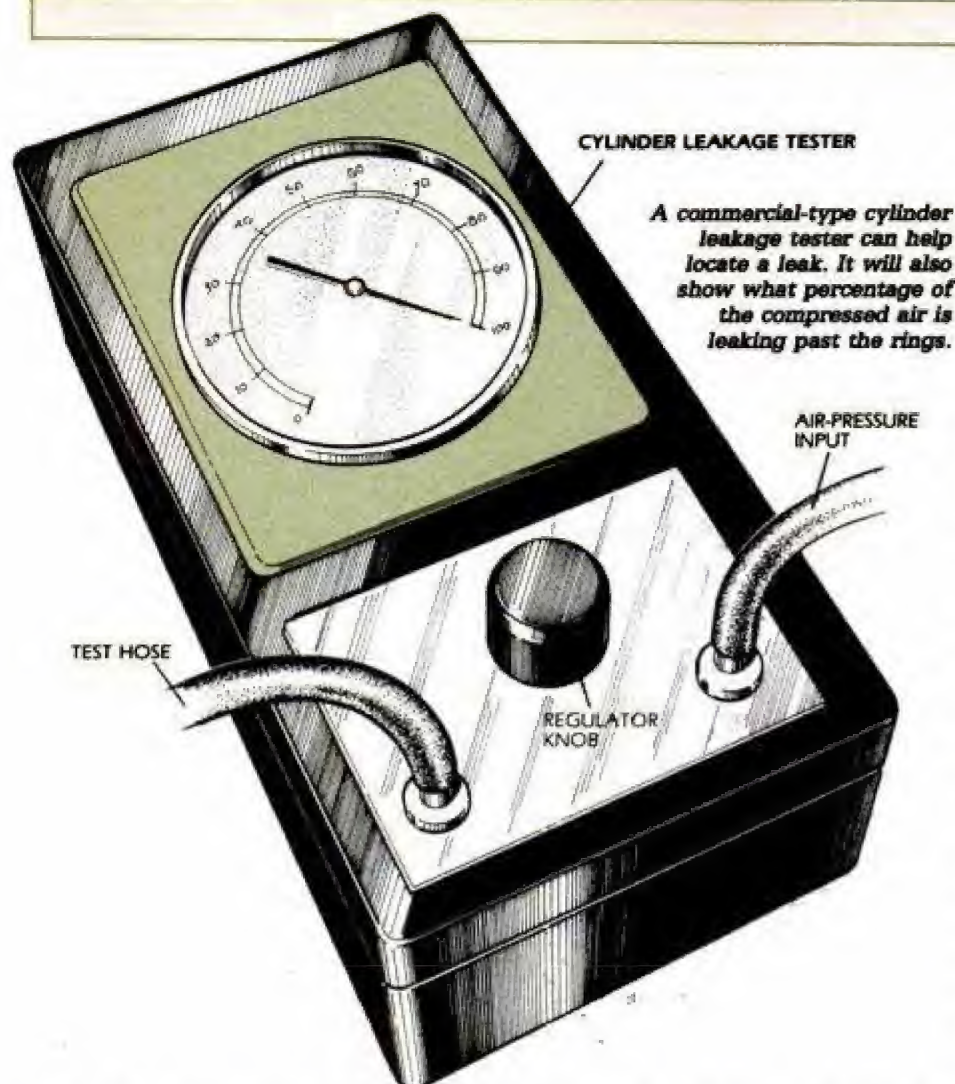
On some engines, you can easily see the top of the piston come up in the bore on compression and exhaust. You can tell which stroke (compression or exhaust) the engine is on by removing the distributor cap. If it's on compression stroke, the rotor should be pointing to the sparkplug wire for the cylinder in question.

Once you're sure that the engine is on TDC for the cylinder to be tested, screw the adapter into the plug hole, adjust the air pressure regulator to 70 or 80 pounds and attach your air hose to the adapter. If you're using a cylinder leakage tester, set the leakage meter at zero before connecting the test hose to the sparkplug adapter. If the engine is not exactly at TDC, the air pressure may force the piston down in the bore. If that happens, you may have to use a wrench to hold the engine in place while you perform the test.

Listening for leakage

With the air supply connected to the cylinder, listen for compression leakage through the exhaust pipe, crankcase oil





filler hole, carburetor opening (with the PCV hose disconnected), adjacent sparkplug holes and the edges of the cylinder head sealing areas.

A leak through either of those last two locations suggests a bad head gasket. If air seems to be rushing out the carburetor, you have a bad intake valve.

Leaking exhaust valves will produce a hissing noise in the exhaust pipe. If you detect air hissing out through the oil filler hole, the rings are worn.

After listening for air leakage at all locations mentioned above, remove the radiator cap and look for bubbles in the coolant. Their presence would indicate a leaking head gasket or cracked cylinder head.

Remember that you're looking for the point of excessive leakage. There will always be some leakage past the rings. If jiggling the engine with a wrench on the front pulley increases the size of the leak significantly, the ring lands may be worn.

Exhaust valve leakage can be caused by dirt on the seat.

Some mechanics like to tap firmly on the top of the exhaust valve stem with a brass hammer while checking cylinder leakage. This will release a burst of air

past the valve which can help dislodge any particles that may be creating a leak. It can also temporarily seat a valve that may not seat well under operating conditions, due to a worn valve guide. So this practice can be somewhat deceiving. If you do stop an exhaust valve leak in this manner, crank the engine two complete revolutions and see if the leak recurs. If it does, the problem is probably the result of a worn guide.

Using a commercial tester

If you're using the commercial cylinder leakage tester for the air leak test, you'll get a percentage reading of cylinder leakage.

The leading manufacturer of this type of equipment specifies 20 percent or more as a failure level. Race car engine builders usually look for less than 5 percent cylinder leakage. Again, it's all a matter of how fussy you are. Most high-quality production engines that we have tested leak less than 10 percent.

When testing a cylinder that showed evidence of oil fouling on the sparkplug, allow the air hose to remain connected to the cylinder for at least five minutes. This will blow excess oil past

the rings, if the ring seal is poor, allowing a more accurate reading.

After the No. 1 cylinder has been leak tested, continue checking other cylinders that failed the cranking compression test.

You may want to test all cylinders if you have a commercial leakage tester. You should obviously leak test any cylinders that showed evidence of oil fouling. If you marked your crankshaft pulley for TDC locations, the second cylinder in the engine's firing order should be tested after No. 1. Simply rotate the engine to the next mark.

As explained previously, it will take two full revolutions to bring all cylinders to TDC. If you're using the whistle or eyeball method to determine TDC, you can simply move on to the next cylinder on the bank.

Plugging the hole

Once you have determined the source and the seriousness of a compression leak, a repair decision must be made. Some leaks may not be worth repairing.

For example, a leaking compression ring that falls right at the 25 percent failure figure on the cranking test and produces perhaps 30 percent leakage with the commercial cylinder leakage tester may not be worth repairing, particularly on an older vehicle. On the other hand, a leaking exhaust valve that produces the same loss of pressure may be worth repairing due to the fact that the job is much less costly and time-consuming, particularly if you can replace your own cylinder head.

If you find that your engine needs new piston rings, a complete engine rebuild is called for. The powerplants of 15 or 20 years ago were frequently re-ringed right in the car. The mechanic simply pulled the heads, dropped the pan and knocked the pistons out. He would then hone the cylinder walls while standing on a fender, install new rings on the pistons and new bearing inserts on the rods and drop them in.

If your mechanic tries to tell you that he can repair your late-model, small-displacement engine in such a manner, find a new mechanic. Today's engines are built to much closer tolerances, and, consequently, repairs involve considerably more precise measurements and expert machine work.

Don't take a chance on haphazard repairs. If your engine failed in original equipment form, you certainly don't want it rebuilt to specs that are even looser than the original equipment specs.

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THE PM GARAGE



Nut starter

Starting threaded fasteners in tight quarters can be a real struggle, which is why screw and bolt starters are popular. Now there's a tool that starts something even smaller—the nut.

Pull an adjusting sleeve back and spring-metal stepped prongs expand to grip tightly, part of the way into the nut. You thread on the nut far enough so it holds, then pull away the tool and finish tightening with a wrench.



Starter tool has stepped prongs for better grip on nut. —Paul Weissler

The starter grips any nut up to $\frac{3}{16}$ -inch internal opening and is \$4.75. For details, you should contact Cal-Van Tools, 1500 Walter Ave., Fremont, Ohio 43420.

Fuse puller/installer



Unhook one end of a cylindrical fuse with the tool. Then pull with your fingers.

A new fuse puller/installer works even on normally difficult cylindrical fuses. One end of the tool has a hook you slip behind the cylindrical fuse. Pull on the tool and one end of the fuse. The other end of the tool has a pair of jaws that hold the fuse so you can push it into the holder. The jaws also lock onto the blade fuse, so you can yank it or install it. Once a fuse is installed, twist the tool to disengage the jaws. The plastic tool costs about a dollar. From Bussman Div., McGraw-Edison Co., Box 14460, St. Louis, Mo. 63178.—Paul Weissler

Drain without pain

Because of the cramped undersides of many cars, transmission and differential drain plugs are extremely difficult to get at.

You can't use a jackrabbit-type pump because the gear oil is too viscous. And you can't siphon it out for the same reason.

The Sludge Pump by LSK Automotive Accessories provides the answer, however. You simply insert the tube down the fill hole and pump away.

This hand pump is really effective, as I've found out by doing a dozen jobs with it.

And the price is right—about \$2.95. It's available at most auto supply stores.

If you can't find it, contact the manufacturer directly: Valley Distributing Co., LKS Automotive Accessories,



Hand pump can squeeze into tight places.

2540 North 29th Ave., Phoenix, Ariz. 85009.—John W. Lamm

Exhaust hanger

A semi-universal exhaust hanger overcomes the installation problems normally associated with repair of exhaust systems.

Called Hang-It-All, it covers Ford and GM cars with the rubber loop hanger, plus some other U.S. and imported cars.

The hanger is a kit you can assemble in any one of many ways. It has an L-shaped mounting bracket with slotted holes, plus a pipe bracket and rubber loop with round holes short distances apart, so the hanger can extend vertically or horizontally. Also, the pipe bracket can be set at an angle without twisting the loop. Price is about \$2. From Nickson Industries, Plainville, Conn. 06062.—Paul Weissler



Semi-universal exhaust hanger can be assembled in a number of different ways.

Drill bit holder

Drill bits are easy to lose, and if you have several sizes out for one job, it's not always easy to tell which size is which. A rotary dispenser that attaches to the drill cord handles both problems.

The dispenser, which lists for \$18, comes with 13 bits ($\frac{1}{16}$ through $\frac{1}{4}$ inch). Turn the top to line up an arrow with the size you want. Outlet holes in the dispenser also align, and the bit then slides out.



With the dispenser's top arrow at the desired size, the drill bit can slide out.

When you're done, slide the bit back in, then turn the top to the next size you need. It works like a charm. It's from Henry L. Hanson Inc., Box 226, Worcester, Mass. 01606.

—Mike Lamm

HOMEOWNERS' CLINIC



Thwarting raiders

I have several dwarf apple and peach trees in my yard. Each year the squirrels raid the trees a week or two before I'm ready to pick. Do you have a solution? The animals can get to the lower limbs, even though I put a barrier around the trunk. —Dale R. Hines, Dayton, Ohio

Try picking the fruit about a week before it's ripe. It will finish ripening indoors, and the aroma and full color will be less likely to attract the squirrels. Also, hang some twirling and noisy items from the trees and on sticks driven into the ground.

If that doesn't work, a single-strand electric fence on insulators placed 2 to 6 in. above the ground, topped by wire

mesh on insulators, will deter squirrels. Be sure the controller (charger) is listed by Underwriters Laboratories Inc. This will ensure that the current's magnitude and duration are within an acceptable level for humans and animals. Both electric (110-120 v.) and battery-powered (6 and 12 v.) controllers are available. Sears is one equipment source. Follow directions with the equipment. Check with your local building department before you buy to make certain the fence is allowed in your neighborhood. I'd also alert neighbors who have small children.

You might also try bird netting, which has been known to keep squirrels out of gardens, even though it's not

guaranteed for that purpose. It's a woven nylon netting of about 1-in. mesh. A 9×21-ft. net is about \$10.

Also, you could try a finer mesh net called Insectinet. This net is knitted from 100 percent nylon. A 15×20-ft. net costs about \$9, and prices range to \$35 for a 15×100-ft. net. They're available from French Textile Co. Inc., 835 Bloomfield Ave., Clifton, N.J. 07012. Send a stamped, self-addressed, legal-size envelope for a price list.

An excellent booklet on electric fences is published by Cooperative Extension Service, University of Georgia College of Agriculture, 101 Court Square, Decatur, Ga. 30030. Send a stamped, self-addressed, legal-size envelope, if the booklet isn't available from your county extension agent.

CO detector

With the great number of unvented kerosene, natural gas and LP gas heaters in use, and the ensuing danger of carbon monoxide (CO), you'd think there would be a great demand for CO detectors similar to smoke detectors. I know that there are laboratory instruments, but they're very expensive. Is there a product for homeowners? —F.J. Collins, Glenham, N.Y.

Carbon monoxide is a colorless, odorless, very poisonous gas formed when carbon burns with an insufficient supply of air. To detect it you do need a sophisticated monitor. The one shown here is about \$530.

I realize that anyone trying to cut down on heating bills by using supplemental space heaters won't be happy with that added expense, but you can't equate payback with the saving of a life. If an oil, gas, kerosene, coal or wood stove is starved of air necessary for combustion, it will operate inefficiently and produce large quantities of carbon monoxide. When using a space heater, make certain that you supply adequate combustion air.

If you have any doubts about the heater you are about to purchase, call the toll-free hot line of the U.S. Consumer Product Safety Commission, 800-638-2772.

You should also check with the heating and ventilating division of your local building department to make cer-



This battery-powered, carbon monoxide indicator sounds an alarm if the CO concentration exceeds a preset level.

tain that the heater you're thinking about buying meets the local code.

For the name of the nearest dealer for MiniCO Carbon Monoxide Indicator, Model IV, write: MSA, Mine Safety Appliance Co., 600 Penn Center Blvd., Pittsburgh, Pa. 15235.

Vinyl-clad story

A salesman called on my wife and me recently and wanted to sell us vinyl siding for the wood part of our wood and brick veneer, one-story house. He said it would not only eliminate painting, but it would increase the value of our house by approximately 25 percent. I would appreciate anything you have to say about this, along with answers to these questions: Does vinyl or aluminum siding breathe? How many years

will such material last? —F.L. Frederickson, Jacksonville, Tex.

Not being in the real estate appraisal business, I can't vouch for the 25 percent value increase (the figure seems high, unless your wood siding is in deplorable shape). But I can attest to the elimination of painting. My experience has been with a siding made by Mastic Corp., a subsidiary of Bethlehem, South Bend, Ind., 46624-0065 (the numbers are the new zip code). Although the material itself doesn't "breathe," vapor can pass through at each of its "T-lok" joints. Mastic Corp. backs T-lok vinyl siding with a 50-year, nonprorated limited warranty.

Remember, though, metal and vinyl sidings are hung in nailing slots, not nailed tightly. This allows the material to expand and contract with temperature changes. Certainteed and Bird & Son are other vinyl siding makers.

If you choose vinyl siding, know your installer. It's very important that he be familiar with installing composition sidings. (The siding manufacturer may have a list of installers he feels are competent to install his material.) **PM**

Do you have a home-maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in the column. For more home-repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send your order(s) to Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

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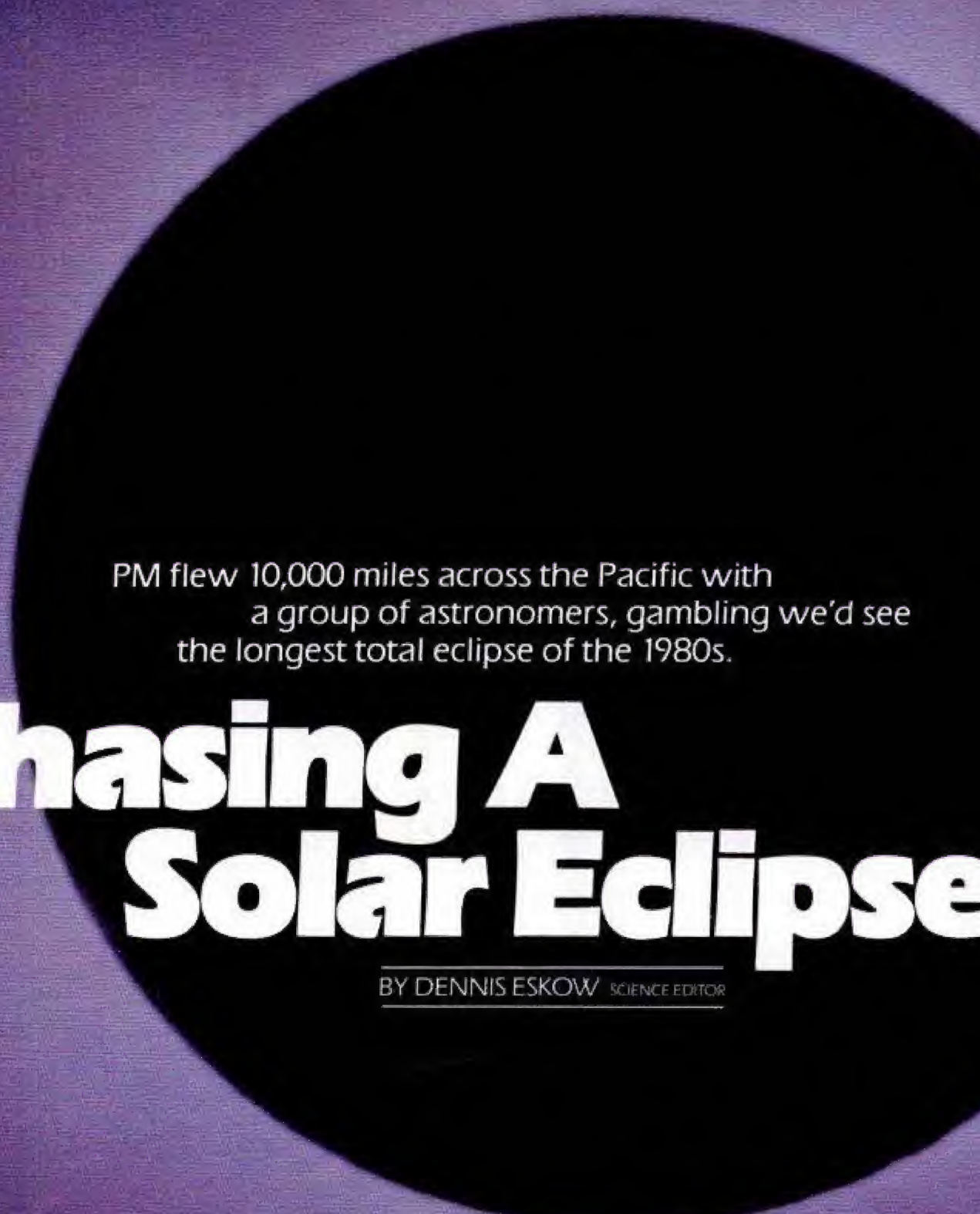
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PM flew 10,000 miles across the Pacific with
a group of astronomers, gambling we'd see
the longest total eclipse of the 1980s.

Chasing A Solar Eclipse

BY DENNIS ESKOW SCIENCE EDITOR



PM astrophotos:
Robert Little, George Keene

On a soccer field at the jungle's edge in the center of the universe, the giant known as *Kalau Rau* kept a bloody vow and began to swallow the sun. We watched in amazement along with hundreds of astronomers and astrophotographers who had traveled 10,000 miles from America to see the *Grehan Mata Hari Total*—the total solar eclipse of 1983.

It would be the longest eclipse of the decade—five full minutes of total darkness in which to photograph the sun's outer atmosphere and perform experiments. It also would mark astronomers' first use of two important new technologies: Polaroid instant 35-mm slides and Kodacolor 1000 ASA color print film. But the event's real significance was in the setting itself: the Central Java jungle, where Buddhist gods continue to live out the dramas of a thousand years and where American eclipse-chasers nearly lost their biggest gamble of the 1980s.

Thousands of professional and amateur astronomers plunked down bundles of cash to chase the sun, betting they would have their best chance ever to capture an eclipse on film. After all, the sun would cross Central Java in the middle of the dry season and during one of the worst droughts in Indonesian history. Clear skies could be reasonably expected over the eclipse scene, a string of islands running west-east from Indonesia to just off the Australian coast.

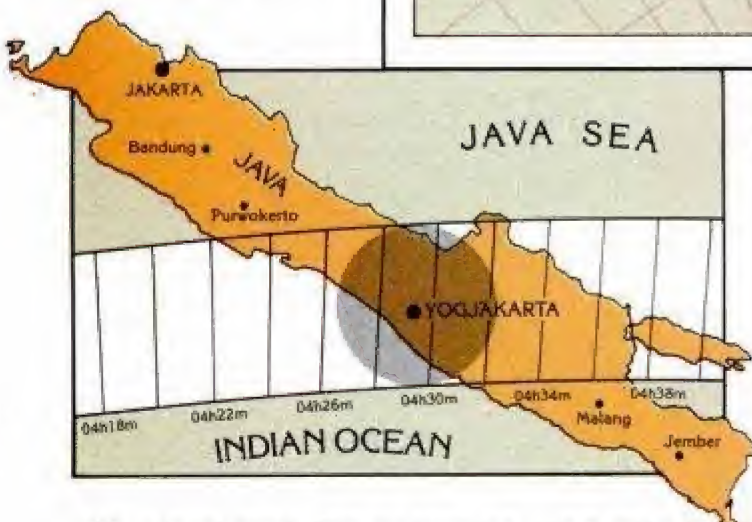
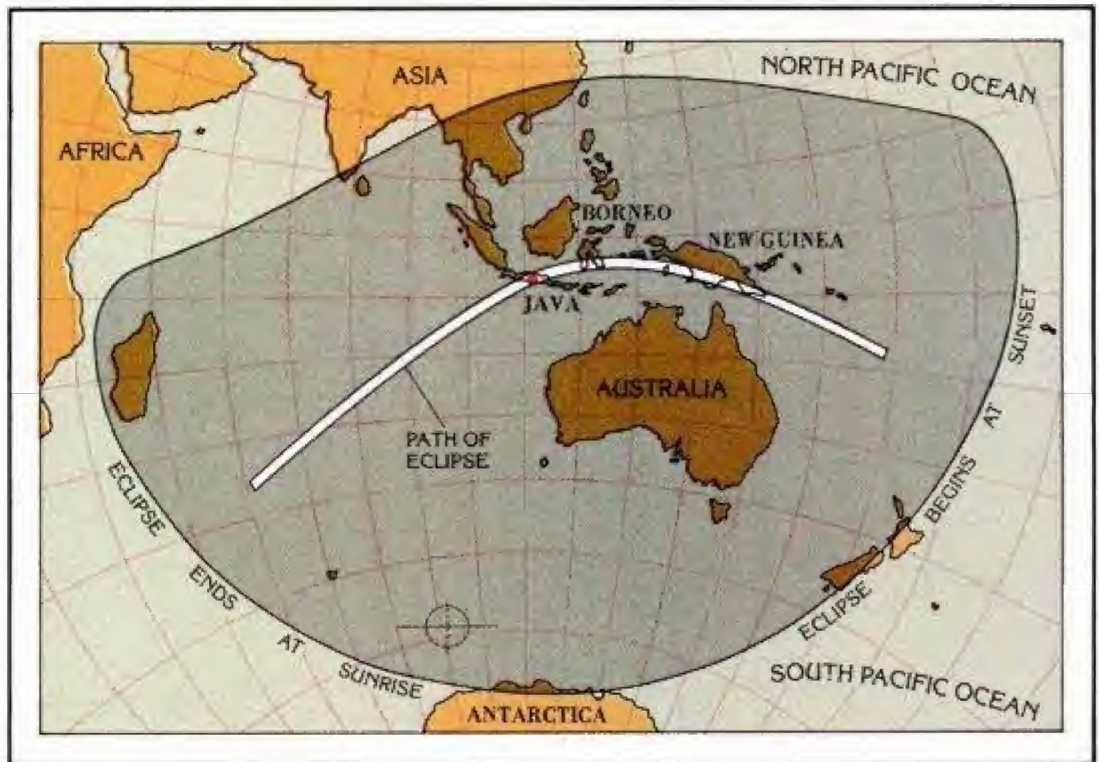
On the night I arrived in Jakarta I was hit

PM photo: Leif Robinson

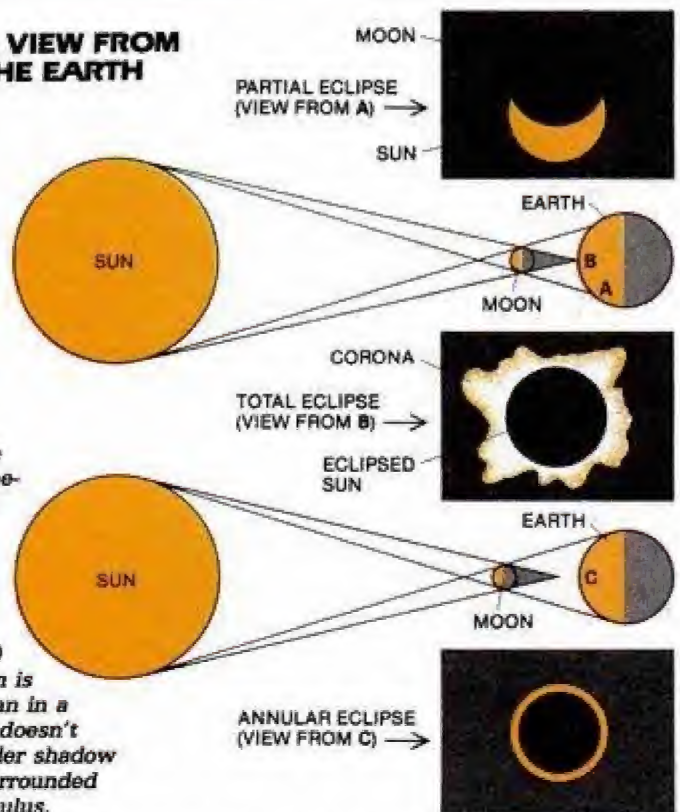


We caught the total eclipse on film. Sun's corona (facing page) is seen at mid-totality. Flattened light at the poles indicates solar magnetic pull. In the sequence photos: 1. first contact of moon shadow on sun; 2. during totality, Bailey's beads form at 9 o'clock; 3. solar flares show at 7 o'clock; 4. polar brushes—the wispy light at the flattened part of the sun—are seen; 5. "diamond ring" effect is recorded as moon's shadow passes away from the sun. All eclipse shots were taken with Polaroid instant slide film, except photos 3 and 5, taken with Kodak Ektachrome 64 ASA film. Photographer Robert Little (above) is with PM Science Editor Dennis Eskow (left) and astronomer Fred Espenak in field just before eclipse.

The eclipse's path of totality (right) began in the Indian Ocean, spread over Indonesia and swept out past Australia into the Pacific. It was about 2,000 miles long. The eclipse was in its last phase at sunrise on the western extreme and in its first phase at sunset on the eastern extreme. The moon's shadow moved along the path at about 600 mph, putting on its show for slightly more than three hours. The center of the 200-mile-wide eclipse path fell over Central Java and its capital, Yogyakarta (below). North and south of the path, the eclipse was partial.



A VIEW FROM THE EARTH



with cultural shock. The air hung hot and humid, heavy with the aroma of incense cigarettes called Kretek, so named for the crackling sound they make when you light them up. Gone was the Western-style Muzak. Instead, the night was filled with Islamic wailing and Buddhist bells. Poker-faced military policemen watched the scene carefully. Reports in the English-language press hinted ominously at the existence of "death squads," semi-official troops who would shoot any national caught hurting a foreigner. Dark, gaunt natives dressed in thin cloth and black fezzes huddled together barefoot on the floor of the airport terminal. Beggars?

"Pilgrims to Mecca," explained my guide, Hapsah Karlono. "They are going to pray and fast for Ramadan. Holy month."

As we walked into the torrid night, I gazed at the sky and groaned, "It's cloudy." Not a star shone. I had spent nearly 22 hours on a jumbo jet from New York to Tokyo, then on to Jakarta and, finally, Central Java.

In a total solar eclipse (right, top), moon is between Earth and sun. Anyone in shadow path (B) sees a total eclipse. Just outside (A), eclipse appears partial. An annular eclipse (right, bottom) occurs when the moon is farther from Earth than in a total eclipse. Shadow doesn't quite touch. View under shadow (C) is of black disk surrounded by a fiery ring or annulus.

"Many pray for clouds," Hapsah said.

"To go away," I nodded.

"No. To stay. The *Grehan Mata Hari Total* is bad for luck, maybe." In an unorthodox mixture of Islamic, Hindu and Buddhist myths, many Indonesians believe the viewing of an eclipse brings a curse.

That night I prayed, too. I hardly slept. And my stomach turned somersaults on the next day's one-hour flight to Yogyakarta (Johg'-juh-kar'-tuh), capital of Central Java and Hindu-Buddhist

Center of the Universe. There, I joined a group of eclipse-chasers who were accompanied by a team of experienced astrophotographers. The leader, Robert Little, who was on his 10th eclipse chase, would photograph the phenomenon for *Popular Mechanics* using the new ASA 40 Polaroid slide film. A tour guide, NASA astronomer Fred Espenak, planned independent research on the accuracy of eclipse predictions. Leif Robinson, editor of the astronomy journal *Sky And Telescope*, was prepared to shoot the eclipse with the new, very

high-speed Kodak 1000 color film.

Little, Robinson, several other tour leaders and I huddled in a steamy hotel room to hash out the options in case of clouds on eclipse day, now less than two days away. We had cirrus clouds at just over 25,000 feet, Robinson had observed on flying in from Bali. At 15,000 feet he saw another layer of wispy cirrus clouds. And a deck of cumulus clouds clung to the top of a nearby volcano at about 10,000 feet. No one liked the emerging weather picture. So, while some team members went off in search of weather data, Robinson and I agreed to charter a plane.

It was hard to get anyone to talk about the eclipse, or to admit to any *angst* about the sudden turn of bad weather. Eclipse-chasers—professional and amateur—are a breed apart. Their enthusiasm is so great that they'd rather surrender their passports than miss a solar eclipse.

"I'm not sure how many of these I've been to—maybe seven or eight," said Krystyna Jaworowska, a Smith College astronomer. She said she had come for the tour. The eclipse itself was just part of the experience.

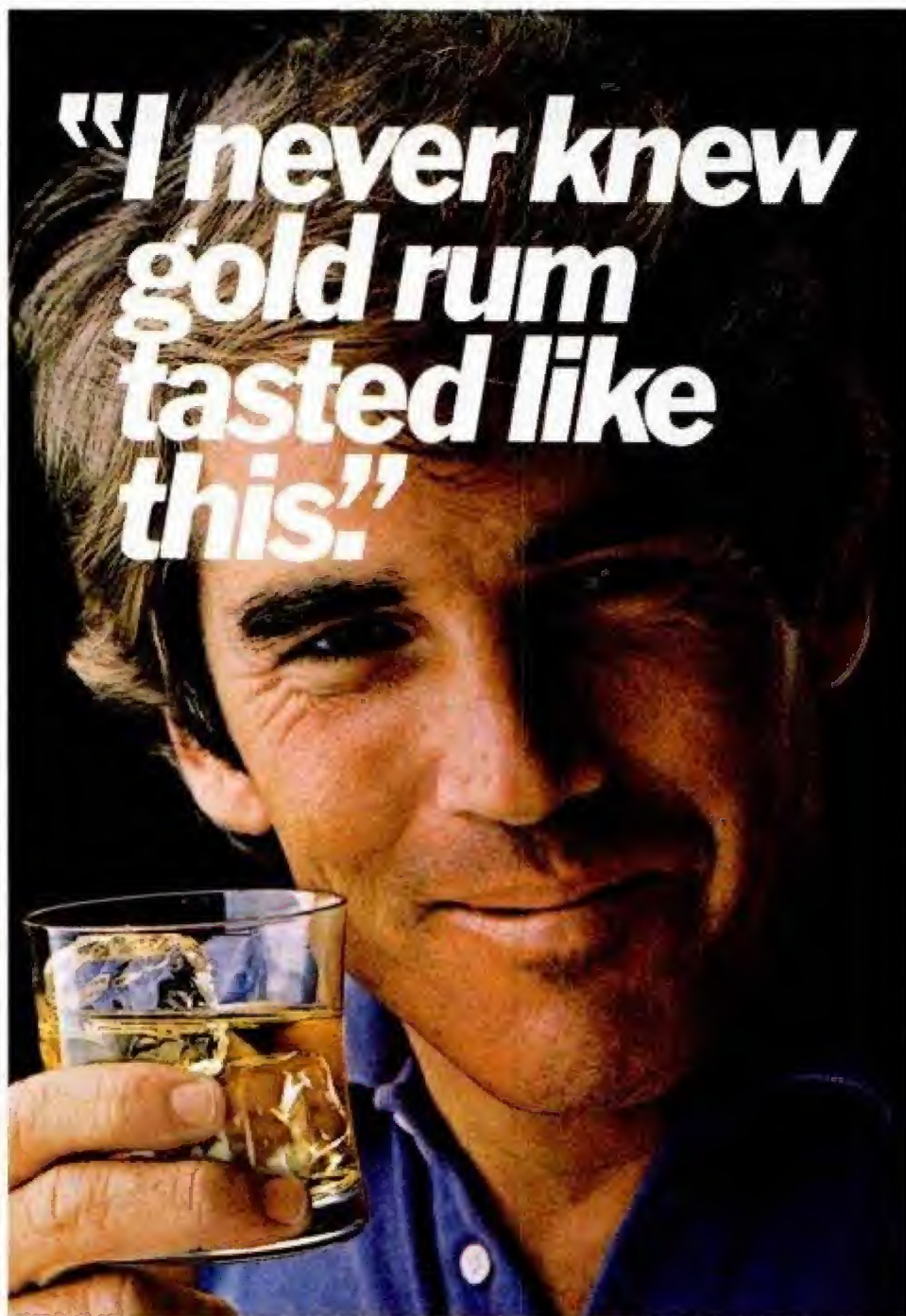
"There is little mystery. Man has photographed every aspect of an eclipse since the turn of the century," Little pointed out. And it was the ancient forefathers of these Indonesian mystics who figured out that a total solar eclipse happens when the new moon comes between the Earth and the sun. The combination casts a shadow on the Earth about 200 miles wide and, in this year's eclipse, about 2,000 miles long. The Moslems, who set their holy months by the first crescent of the new moon, can predict eclipses accurately.

Experiments during the eclipse

Most of the experiments planned for the *Grehan Mata Hari Total* were important to specialists in the field. By timing the four major phases or "contacts" of the eclipse to the split second, Espenak hoped to contribute new knowledge on the accuracy of our maps of the solar and lunar paths around the sky. The path of the moon around the Earth is about 5° off the path the Earth takes around the sun. Only when the paths intersect at new moon is there a possibility of an eclipse. At another location, astronomer Alan Seltzer hoped to measure changes in the Earth's atmosphere from the last total solar eclipse in July 1981. Many people planned to watch and log changes in temperature during totality.

On a tour of the Borodupur temple, we saw a makeshift rampart where Indonesian National Television was setting up video cameras to cover the next day's event. It was part of a national

(Please turn to page 54)



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CHASING A SOLAR ECLIPSE

(Continued from page 53)

effort to keep natives inside at eclipse time. Even the Indonesian Air Force planned to send up aircraft to capture the eclipse. But that meant bad news.

"There's no plane for us," Robinson announced. "They won't let the pilot file a flight plan." But Robinson also had good news. The weather was changing, although we couldn't be certain to what degree.

That night, before dinner, Little let everybody know our options. We could get on our tour buses and head out of the path of the moving weather, or we could take a ride to the site originally set aside for our group about half an hour away. By acclamation, the group voted to run if necessary, but to go to the original site if possible.

We started to pack our equipment for the morning's journey: telescopes, camera, film, reverse clock drive telescopes to follow the sun. We packed sheets of aluminized Mylar to filter out the most blinding solar rays just before and after totality. (Never look directly at the sun without protection. Many astronomers have gone blind ignoring this maxim.) We also made viewing "glasses." To protect our eyes, we stuck two 35-mm slides with double sheets of exposed

film on a wand so we could hold the slides to our eyes like opera glasses.

Few people slept at all the night before the eclipse. Like little children, they ran outside periodically to catch a glimpse of any twinkling light.

The shortest night

I caught about three hours of sleep, then leaped out of bed, showered, packed and joined the others at the tour buses just as the sun began to rise. The clouds were breaking up, and we left for our original site three hours before first contact—when the disks of the moon and sun just touch one another for the first time. After the first contact, totality was about an hour away.

When we arrived at the school soccer field, state police ringed the area to keep out the locals. Even before the darkness of second contact—when the disk of the moon covers the solar disk and only the sun's outer corona shows—roosters crowed and birds flew to their nests.

Totality reduced most of us Americans to a very primitive state of mind as well. The day turned not to night, but to something quite different. A golden darkness drenched the land, giving it a copper tint, and the corona glimmered around the darkened sun like an obsidian marble set in a ring of fire. Some in

the party let out primal screams, others applauded.

I trembled and felt tears of raw emotion well up inside. The universe was open before us for a brief instant, and I was privileged to watch. The Polaroid photos taken by Little were literally an instant success. He had shot the low ASA film at exposures ranging from 1/4 second to 4 seconds. The results were impressive.

Some photographers complained of a jiggle they felt at mid-eclipse. Later we would hear a report from the Indonesia geological service of an earthquake off the Java coast that measured 5 on the Richter scale. In addition to the astrophotos, the Polaroid was useful for scene-setting shots. The low ASA was manageable, if you had a good camera. We used a Nikon F-3 manually, mounted on a tripod.

No one tried to hide the emotion that comes with this kind of victory. There were tears and hugs and promises to meet again for another solar eclipse, perhaps the total eclipse of 1984, which will be seen over New Guinea, also in the South Pacific.

The giant, *Kalau Rau*, had been driven away. Indonesians had done well, for he will not return until the next *Grehan Mata Hari Total*, scheduled over Indonesia 250 years from now. **PM**

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IT'S A NATURAL!**
AND THERE'S EVEN MORE...



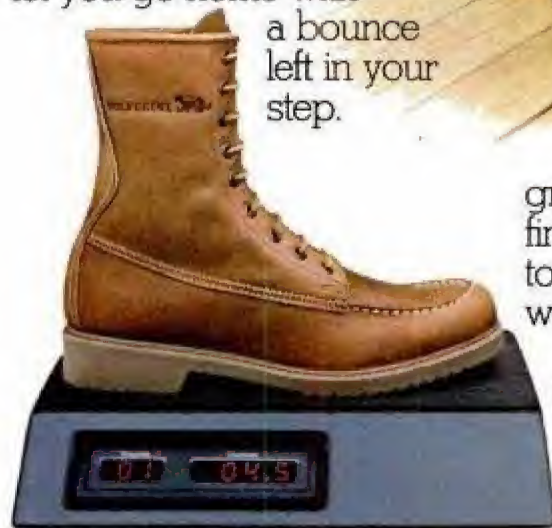
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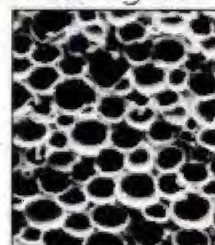


grained cowhide we can find, and specially treat it to resist everything from water to acid.

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is comfort.

The microcellular composition of our sole material is what makes the difference. In a microscopic view, you can see that the material is permeated with airholes that lighten its weight while also helping to absorb shock. In effect, you're walking on a cushion of air. And, the result is a perfect combination of dependable toughness and incredible comfort.



Microscopic View

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When you make boots for people who wear them to make their living, like we've been doing for over 75 years, you learn a thing or two.

You learn to make boots that look good, feel good, and last a good long time. And, you learn not to put your name on anything less.



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Right out of the pages of World War II. There's never been a collection like it before. And for a very good reason. Test pilot Chuck Yeager — who was a decorated World War II fighter pilot before he broke the sound barrier in the X-1 rocket plane — helped put it all together.

The collection features authentic World War II design, and everything is of

high quality. And as an added touch, each item bears our exclusive X-1 emblem — embroidered on the clothing, stenciled on the sunglass case. The X-1 emblem will be a sure sign to everyone that you know what's "the right stuff." And that you also know AC-Delco is the way to go for the right parts.



(A) Pilot's A-2 Leather Jacket. Identical to original in all details. Oil-tanned naked calfskin leathers. Lining: 65/35 polycotton blend. Knit trim of nylon acrylic blend for durability.

(B) Pilot's Coverall. 50/50 cotton polyester. Updated with front zipper and VELCRO® closures on all pockets and waist. Chest pen slot in breast pocket.

(C) Tank Commander's Jacket. Warm, lightweight. Shell: 65/35 polycotton military twill. Lining: melton wool. Brass zipper. Knit trim of nylon acrylic blend for durability.



(D) Flight Vest. Shell: military specification nylon flight satin. Lining: survival orange nylon. Epaulets. Cigarette/pen pocket. Knit trim is nylon acrylic blend for durability.



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(B) Pilot's Coverall*	\$ 44.00			
(C) Tank Commander's Jacket*	\$ 52.00			
(D) Flight Vest*	\$ 39.00			
(E) Aviator Sunglasses	\$ 20.00			

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THE PM WORKBENCH

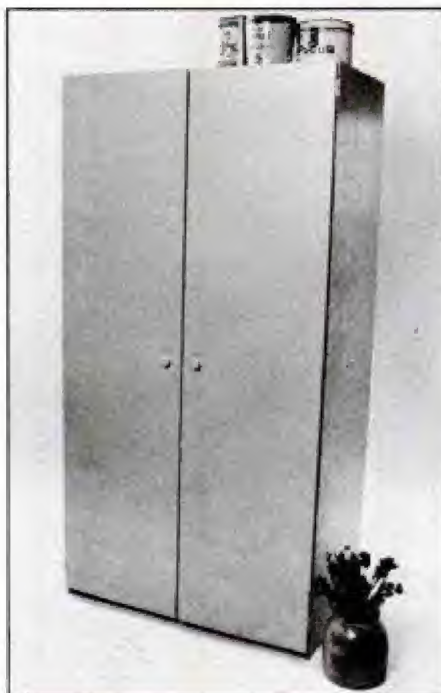


Closet from a kit

Here's a quick, easy and inexpensive way to add storage space. Affordably priced at \$69.95, the Sturdi-Craft particleboard wardrobe unit shown (Model WR-912) comes in kit form. It measures 20 in. deep \times 36 in. wide \times 72 in. high. This piece is one of many kit models sold through Sears, J.C. Penney and home centers. For details, contact Sturdi-Craft, 200 Boylston St., Chestnut Hill, Mass. 02167.—H.W.



Assembling the particleboard cabinet took about 30 minutes. Note the door support while the hinges are installed.



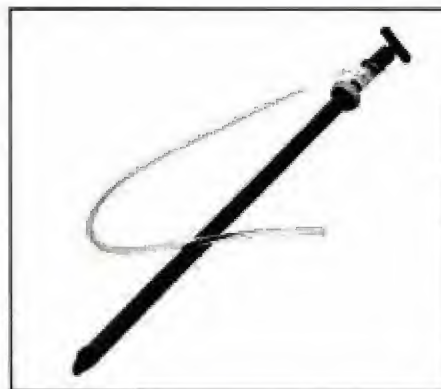
Built from a kit, the wardrobe cabinet shown is one of many models available.

Rental industry caters to do-it-yourselfers

The 27th Annual Convention and Rental Equipment Show was attended recently by our man in Atlanta, John Gaynor. He reports that the convention's vastness—over 5,000 rental people viewing 200,000 sq. ft. of exhibits—attests to the growth of the rental industry today. The first convention in 1957 had 53 members and attracted 100 people. Gaynor reminds us that, "Although there's no equal to owning your own tools, there are times you'll need a rarely used tool for a one-time job and that's where the rental industry comes in."—J.T.

Pumping kero

Despite all the commotion over kerosene heaters, many homeowners—myself included—find these auxiliary heaters a satisfying way to save heating dollars. Now, some manufacturers are producing equipment to make ker-



This handy tool pumps or siphons kerosene neatly from a drum directly into kerosene heater or an approved container.

osene heating safer and more pleasant to handle.

The Lift/Siphon pump, by Beckson Products Inc., Box 323, Clinton, Conn. 06413, fits onto any 30- or 55-gallon drum with a 2-in.-dia. bung opening to make transferring fuel easy and safe. It's \$18.50 through industrial supply houses or from the maker.—H.W.

All pumped up

This top quality polyethylene sprayer from Melnor Industries, 1 Carol Place, Moonachie, N.J. 07074, is about as handy a compressed-air sprayer as I have ever used. The rig comes with two nozzles, small for superfine mist to jet stream and large for mist to super-



Model 90 sprayer (inset) has a 1½-gallon operating capacity. The carrying handle tilts to one side to permit pumping.

distance jet stream (for spraying trees). The 1½-gallon operating capacity sprayer shown here (Model 90) costs \$44.99. You can also get a 2½-gallon sprayer (Model 92) for \$49.99.—H.W.

UPDATE

Included in *The PM Workbench* in June 1983 was an item about a solar-powered radio.

We recently learned that the company selling the radio, the Homesteaders Warehouse, Roseburg, Ore., has gone out of business. All orders that have been sent to this company will be returned to sender by the post office.—J.T.

If you've come across a new product with some special features, let us know about it. Write to PM Workbench, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019.



Phone Extortion

Let's put the screws to our phone suppliers on a terrific long range cordless phone with a novel new consumer buying tool called GREED!

It's a war. The major phone suppliers are each desperately trying to lock up big orders. And now, we've devised a plan to take advantage of their greed.

Together we can apply enough pressure to get you a super high quality cordless phone with a range up to 700' for just \$79. And, hopefully we'll make a good profit for ourselves. But, there's a problem.

TIGHTEN THE SCREWS

Before I tell you all about the great features and sound of the phone, let me explain just how we plan to deliver these phones for such an admittedly foolhardy price. You see, it's called extortion (legal definition please) and it works like this.

There are two large phone companies that are trying to get DAK's phone business. To be perfectly honest, the quality, guarantee and sound are so close that we couldn't decide between the two.

Even their prices are close. So here's what we did. We got quotes from both of them for 5,000, then for 50,000 phones.

And, here's what we decided. As you place your orders, we'll offer each of the two companies a check (cash in advance) for the number of phones we need.

The company with the **lowest price of the day** will get that day's order. You see, your orders give us incredible leverage.

Usually we buy just one phone from one supplier. Unfortunately once they have a contract with us, they have no incentive to lower our price. And, at our costs today, we really can't come out at only \$79.

SAFE INVESTMENT

Don't worry about your \$79. DAK is a large company. If this plan to sell 50,000 phones fizzles out, we'll still be OK. Plus, DAK doesn't even charge your credit card until **after** we ship.

And most important. Each phone will come to you in its factory sealed carton, and will be backed by the manufacturer's standard limited warranty.

Finally, you won't be getting a cheap

stripped down phone. We aren't dumb. We picked the phones we wanted **before** we got the quotes. So, nobody can make any changes to come out lowest.

And frankly we'll get 50,000 of you new customers (we have 290,000 now) to send our 68 page electronics catalog to. So, even if it does fizzle, we're sure to get another chance at you later.

A GREAT LONG RANGE PHONE

So, now let's see if this is really going to be a stripped down low quality phone. Remember, each and every feature I describe appears on both phones. And, if for some emotional reason you want to specify which phone you want, no problem, I've got a way for you to do that too.

Imagine walking from room to room in your home talking on the phone. You'll go out and get the mail, walk over to a neighbor's or work in the yard or the garage.

It's a superb personal security device. You can instantly call a doctor or police from anywhere you happen to be.

And, if you are needed at home, no problem. There's a page button on the base that beeps you at the handset which then becomes a wireless intercom.

Cordless phones are a great combination of posh luxury and life saving utility.

NO INSTALLATION

If you can plug in a lamp you can install your new cordless phone. Just plug in the modular phone plug and the AC line cord, then start talking. The phone uses universal pulse dialing compatible with both rotary dial and Touch Tone® phone lines.

LOADED WITH FEATURES

Look at these features. You'll have last number redial to redial busy numbers. And, an LED on the base shows when the unit is charging or when the handset is in use.

There's both a standby/talk switch and a power off switch so that you don't have to return the handset to the base when you aren't using it.

And when you do put the handset in the

base, its heavy duty NiCad batteries recharge automatically, and a security system protects your base station.

If you're adjusting a TV antenna, the person at the base can talk to you using the intercom feature and any of your regular house phones. So, you'll have a cordless intercom, with a range up to 700 ft too.

The two companies that we are trying to 'extort' our low prices from are Computron, and U.S. Tron. Even their names sound alike. Both phones are backed by a manufacturer's standard limited warranty.

TRY TOTAL PHONE FREEDOM RISK FREE

Experience the thrill of total phone freedom as you roam throughout your home, yard or even a neighbor's house. You'll never have to 'run for the phone' again.

Try a cordless phone in your own home risk free. If you don't find the luxury of talking from wherever you are 100% enthralling, just return the phone to DAK in its original box within 30 days for a refund.

To order a long range full featured cordless phone risk free with your credit card, call toll free or send your check for the 'extorted' price of just \$79 plus \$3.50 for postage and handling. Order Number 9700. CA res add 6% sales tax.

If you have a particular love for either phone, you can have your choice for just \$89 plus \$3.50 for postage and handling. To order the U.S. Tron, use Order Number 9701. To order the Computron, use Order Number 9702. So, you'll pay only \$79 if the choice is ours, or \$89 if it's yours.



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PM LOOKS AT...

A Super Vacuum . . . And More



Vacuum parts (top) include Handi-Butler group of accessories. Vac's driveshaft is exposed when cleaning head is off. Above: flexible shaft, chuck, sanding disk, buffer, polishing pad, compounds.

The Kirby is a versatile vacuum cleaner with numerous options. The basic unit is a powerful upright cleaner which converts to tank canister or handy shoulder-strap portable modes. Optional accessories include the Renovation Group and the Home Turbo Group—an orbital sander that removes its own dust, a scrubber, a polisher and massager. You can even buy a barbering attachment. The Handi-Butler Group shown has attachments that you can use for disk sanding, buffing, polishing and drilling.

Kirby Co., 1920 West 114th St., Cleveland, Ohio 44102, manufactures the vacuum cleaner. Suggested retail price for the basic system is approximately \$550. Accessories are extra.

—Rosario Capotosto



Close-up photo of buffer in action. PM tester found this to be a quality tool.



Using the flexible shaft for a workshop drilling task. Chuck's capacity is 1/4 in.



ESCORT WINS AGAIN! JULY 1983 BMWCCA ROUNDEL TEST

"...the filter (ST/O/P) ESCORT is simply outstanding. ...unit decreased non-police alerts by over 90%. ...a price far below that of many other detector units. The ESCORT simply keeps getting better."

ESCORT WINS MAY 1983 CAR and DRIVER TEST

"The Escort looks so comfortable, contented, and familiar at the top of the heap that it's hard to see that something new and special has been added... live with a new Escort for a while and you'll realize it has advanced new circuitry that should go down as a genuine breakthrough."

ESCORT WINS NOV 1982 CAR and DRIVER TEST

"The Escort, a perennial favorite of these black-box comparisons, is still the best radar detector money can buy. The Escort is a quality piece of hardware."

ESCORT WINS DEC 1981 BMWCCA ROUNDEL TEST

"The Escort is a highly sophisticated and sensitive detector that has been steadily improved over the years... In terms of what all it does, nothing else comes close."

ESCORT WINS SEPT 1980 CAR and DRIVER TEST

"Ranked according to performance, the Escort is first choice... The Escort boasts the most careful and clever planning, the most pleasing packaging, and the most solid construction of the lot."

ESCORT WINS MAY 1980 BMWCCA ROUNDEL TEST

"This unit... consistently outperformed the other products and is the standard to which the others are compared. If you want the best, this is it. There is nothing else like it."

ESCORT WINS FEB 1979 CAR and DRIVER TEST

"Only one model, the Escort, truly stood out from the rest... once you try the Escort, all the rest seem a bit primitive. In no test did any of the other detectors even come close."

Talkback with Jerry Galvin

Tune in:
America's New Weekly Satellite Call-In Comedy Talk Show.
"Mr. Galvin is a master... his show is so unusual that people actually set aside time to listen..." (The Wall Street Journal)
Sunday evenings on public radio stations. Check local listings.

ST/O/P**THE
FIRST
RADAR
DETECTION
ADVANCE
SINCE
SUPERHETERODYNE**

ESCORT: "A GENUINE BREAKTHROUGH"

—CAR and DRIVER

If you keep up with magazine tests, you know that ESCORT does more than just outperform other radar detectors. In its most recent evaluation, Car and Driver concluded: "The Escort radar detector is clearly the leader in the field in value, customer service, and performance..." But performance, as measured by warning distance, is *not* the new breakthrough. After all, ESCORT has been beating all comers since its introduction in 1978.

Now There's More To It

While long detection range is obviously essential it does *nothing* to solve a problem that has cropped up in the last year. In fact, increasing range by itself just makes the problem worse. If you already have a good superheterodyne unit, you know what we mean. A new generation of imported detector *transmits* radar signals, and can set off your unit as far as a mile away. The longer the range of your unit, the farther away you find them. As Car and Driver pointed out last November: "Since there are far more detectors on the road than police radar units, interference... could become a genuine nuisance."

Low Level Contamination

At first it was just an irritation. At least ESCORT owners had a way of distinguishing the polluters from the real thing. Our unique audio warning differentiates between the two police radar bands: it "beeps" for X band and "braps" for K band. The polluters' trashy signals triggered both warnings at once, and made a new sound—different than the sounds for police radar. (The rest of the industry didn't even know there was a new problem. Their detectors were making the same sounds as always, just more often.)

Radar Epidemic

As more and more of the "polluting detectors" hit the streets, the problem became more serious. If one of the "polluters" is approaching in an oncoming lane, the alarm from your detector is brief. But if it's traveling the same direction as you, your alarm can go on for miles. And the offending detector doesn't have to be in the car right next to yours. It can be ahead or behind, and up to a mile away. A very serious problem indeed.

Pollution Clean-Up

The problem required an entirely new approach. Examining the interference from these imports, our engineers discovered a subtle difference between their signals and those of police radar, even though they were on the same frequency. The solution, then, was to design new circuitry that would reject the pollution while—and this was the hard part—maintaining ESCORT's industry-leading response to pulsed and instant-on radar. We named it ST/O/P™ (STatistical Operations Processor), and it consists of a CMOS digital processor with built-in memory. ST/O/P is not simple, and it's not cheap. But it is, in our opinion, the most important breakthrough in radar detection since superheterodyne. Car and Driver would seem to agree: "Now, all the world's Radio Shack detectors can hum right by your car in full microwave broadcast mode and your Escort will sit on your dash as politely and silently as a canary-fed cat."

**THE RADAR
DEFENSE
KIT**

Peace of Mind

With ST/O/P, we've put the complications necessary to cope with today's radar problems inside—where they work automatically. Just install ESCORT, plug it into your cigar lighter, and turn it on. ESCORT does the rest. If you encounter a signal from a "polluting detector," ESCORT keeps quiet while maintaining its lookout for police radar. If the signal is the real thing, ESCORT immediately alerts you both audibly and visually. And, unlike other detectors that keep you guessing about the radar's location, ESCORT's signal-strength meter moves upscale as you approach and its variable-rate beeper/brapper pulses faster. You get the full story.

It's Simple

If you want the best, there's no reason to look anywhere else. But don't take our word for it. Try ESCORT *at no risk*. Open the box, install ESCORT on your dash or visor, and take 30 days to test it. If you're not absolutely satisfied, we'll refund your purchase *and* pay for the postage costs to return it. You can't lose. ESCORT is sold factory direct, so knowledgeable support and professional service are only a phone call or parcel delivery away. And we back ESCORT with a full one year limited warranty. Order today and let ESCORT change radar for you forever.

Do It Today

It's easy to order an ESCORT, by mail or by phone.

By Phone: Call us toll free. A member of our sales staff will be glad to answer any questions and take your order. (Please have your Visa or MasterCard at hand when you call).

CALL TOLL FREE . . . 800-543-1608
IN OHIO CALL 800-582-2696

By Mail: We'll need to know your name and street address, daytime phone number, and how many ESCORTs you want. Please enclose a check, money order, or the card number and expiration date from your Visa or MasterCard.



ESCORT (Includes Everything)... \$245.00
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If you order with a bank check, money order, credit card, or wire transfer, your order is processed for shipment immediately. Personal or company checks require an additional 18 days.

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RADAR WARNING RECEIVER

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One Microwave Plaza
Cincinnati, Ohio 45242-9502

FOR ESCORT OWNERS ONLY.

The new ST/O/P technology incorporated in all new ESCORTs is adaptable to all ESCORTs from serial number 200,000 to 399,999. The "ST/O/P Retrofit" costs \$75, and includes adding the ST/O/P digital circuitry with memory and totally retuning and realigning the unit. The ESCORT's one year limited warranty will also be extended to a date one year after the conversion, and of course the shipping costs to return the unit to you are included.

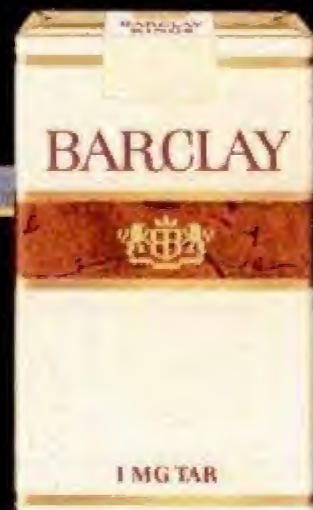
To insure efficient and prompt service, we will use a special reservation system for scheduling the "ST/O/P Retrofit" service. DO NOT SEND YOUR ESCORT, but please send a card or letter (no phone calls, please) with your name, address, and serial number to the following special processing address:
ST/O/P Reservations, P.O. Box 228, Mason, Ohio 45040. We will then send you a special shipping label and details on how and when you can send us your ESCORT.

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The red, white and blue F-16 shakes the desert sagebrush as it zooms by 300 feet overhead at just under the speed of sound. Precisely 4,000 feet from the long runway, Air Force Capt. John Bostick brings up the nose abruptly in a maneuver that takes the warbird into a steep vertical climb. Five G's of gravity claw at every part of his body. At 6,000 feet he kicks the F-16 into a helix of tight vertical rolls, spinning like a top as he heads for the sun. Bostick flips on the smoke generator and a white spiral marks his trail as the plane itself vanishes from view, engine roaring, intake shrieking.

Yes, the Thunderbirds are back.

A year and a half after five members of the Air Force precision flying team were killed in two separate crashes, the slower, less spectacular T-38s have been replaced by six combat-ready F-16s. And in fact, except for the team commander, the whole crew is brand-new to the air show scene.

Bostick, a lean, articulate 31-year-old, likes to point out that the corkscrew trick couldn't have been performed in a T-38. Not enough power. But the F-16 uses only 60 percent of its full power potential to get into the impossible climb—impossible for anyone not flying an F-16, that is.

The January 1982 crash that wiped out the old team occurred in the performance of a fairly routine stunt called the line-abreast loop. It required the four T-38s to loop side-by-side just above the ground. But a loose bolt got lodged in the stabilizer of the lead jet and the closely following team members followed the leader as his craft slammed into the ground. All four were killed

on impact. A fifth team member had died during an exhibition the previous fall.

Following their debut performance earlier this year, the new Thunderbird pilots acknowledged that the memory of the incident still bothered them. Bostick, who had known the four killed in the loose-bolt incident, said that performances kept the memory fresh. But




NEW THUNDER FOR THE THUNDERBIRDS

Even the memory of a tragic crash
can't keep the Air Force Thunderbirds down.
Now they're flying supersonic F-16s.

BY EDWIN KIESTER JR.

PM photo: Michael Huttlinger



2 The jets start rolling left at about 2,000 feet, maneuvering into the diamond formation at 400 knots or more. Then, as the speed is reduced, the F-16s turn upside down in the diamond.

1 At 300 feet and 410 knots, the F-16s nose up sharply. The jets soar, pulling 3 G's, or three times the Earth's gravity.

he stood proudly by his craft and his teammates.

"If your best friend is killed in a car, it doesn't mean you'll never drive a car," the soft-spoken Kentuckian said. "You go on flying in a very professional and safe manner."

Safety is one of the features the Air Force points to with pride regarding the F-16. The front-line supersonic fighter is a multirole air-combat jet and attack craft, with a powerplant that can kick up over 23,000 pounds of thrust with the afterburner on. Besides more-than-needed power, the craft is considered one of the most maneuverable in the NATO fleet. The cockpit is built to hold the pilot comfortably in his seat through 8 G's. And the control stick is a force-feedback type, one which moves the

craft in the direction of the stick according to the force exerted by the pilot. It all adds up to a jet that can run through the most difficult maneuvers with aplomb.

Still, as safe as the aircraft is, and as experienced as the team members are, the Air Force took no chances in preparing for the Thunderbirds' comeback. Maj. Jim Latham, a former Thunderbird wingman, was picked to command the new unit. A call went out for volunteers. Thirty Air Force pilots, each with over 10,000 hours of logged air time, applied. Latham personally screened each candidate, taking him up three times in a two-seat F-16B to check out the candidate's flying skills. As each man was selected, he participated in the screening of the rest. Some of the

(Please turn to page 134)

World-Class Aerobats On The Scene



Like the Thunderbirds, aerobatic teams from other countries and other service branches are making the rounds of air shows throughout the world. An A-4 Skyhawk (above) is one of the U.S. Navy's Blue Angels.



Canada's Snowbirds (above) fly CT-114 Tutor training jets. Japan's self-defense force flies a team called the Blue Impulse (left). Its craft are Mitsubishi T-2a trainers.

GEOMETRY OF A TRAIL TO A DIAMOND ROLL

3 From their final diamond formation at 2,500 feet, the jets go into a sharp dive and gravity goes down to near weightlessness. As they near the grandstands, the F-16s make a turn past the crowd at 300 feet.



Britain's Red Arrows (left) pilot Hawk T-1s. The Netherlands uses only a soloist in an NF-5a Tiger (below).





ROWING SHELLS

Canoeing Was Never Like This

Not canoes, not kayaks, but somewhere in between. And fun.

BY ROBIN NELSON

This overhead shot highlights thin shape of rowing shells. Unlike a rowboat, which has a stationary seat, a shell has seat that moves as you row.

Rowing is the world's best exercise, even better than jogging. That's what its proponents claim. And they may be right. An estimated 60 percent of those who row for fitness are doctors.

Serious rowing is done in specially designed, fine-ended craft with a sliding seat, and with long, dished oars pivoting on outriggers.

Rowing does not leap out and announce itself as a sport for the masses. And it won't—at least not until somebody figures out a way to get about 60 pounds of hand-laid fiber-

glass, plus the associated fine-tolerance hardware, down to the price of a pair of running shoes. But it does offer a routine that involves much more of the body's skeletal musculature than most other popular activities. Racing oarsmen, whether handling sculls (two 9.5-foot oars) or sweeps (a single 12-foot oar), are said to expend more energy per unit time than competitors in any other sport.

The prospects of exercise alone, no matter how beneficial or exhilarating, wouldn't move most of us to invest as much as several thousand dollars in a

classic wooden racing shell. It is called a shell for good reason—if you're not careful, you can easily put your foot through the bottom.

The traditional racing shell is about the most elitist piece of sports equipment ever devised. Yet a few pioneering designers have managed to adapt the concept into a "fitness machine" for the mass market. At between \$1,100 and \$1,300, there are a half-dozen recreational (single-scutt) rowing shells that meet these basic requirements: rugged enough to withstand the novice's inevitable collisions with piers, buoys and other watercraft, and somehow packing near-world-class speed potential into a garageable, cartoppable (18-19 feet long with an average 2-foot beam) hull, even though it may double the weight of a competition shell.

The speed potential is important. World speed records are established at 2,000 meters, about a mile and a quarter. While Olympic "eights" can sprint

(Please turn to page 136)



Alden's 16-foot Ocean Shell has a 25-inch beam. Like most recreational shells, it is made of fiberglass.



PM photos: Frank Lusk



PM's boating editor rows Small Craft's Warning (also opposite). Seat (above) rolls on tracks.



A rowing shell can be carried easily by two persons. This is R.E. Graham's 19-foot Trimline. It weighs 64 pounds and is cartoppable. So are other shells.

DETROIT '84

This is the year that we've all been waiting for: Now, the home team goes on the offensive.



PM photo: Vic Huber

BY GARY WITZENBURG DETROIT AUTO EDITOR

Happily for all of us, not much of George Orwell's prophetic doomsday prose has come to pass. But, amazing as it seems, 1984 is here, especially in Motor City, where they've been working on 1984 since 1979.

And what of the '84 cars? For one thing, high tech and muscle are in. Dull is out. Almost every carmaker is on a youth and performance kick. Cars are fun again, and even the lowliest sedans in the line are being infused with new trim and more power to make them more fun to drive.

Every carmaker is stressing the high-tech nature of his offerings. New lightweight materials, new

electronics, new engines, new body construction processes, new aerodynamics, new, new, new. There's no question that Detroit was stung badly by the import invasion and they're fighting back with a vengeance, mustering every weapon at their disposal to make quality, exciting automobiles that will appeal to Americans.

The 1984 new model crop is one of the heaviest in years. In fact, Chrysler is introducing more new cars in '84 than in any other year in its history. There are so many new models this year that several of the car companies have split up their introductions. Rather than hold the information for a later issue, we're splitting up our coverage, too. You'll get the earliest reports from Chrysler, Ford and Pontiac this month, and more from all the General Motors divisions, Ford



LINCOLN CONTINENTAL MARK VII

First of the showroom stoppers for the model year come from GM and Ford. Pontiac makes history with the first mid-engine sports car from Detroit. The two-seater Fiero began as a doodle for a high-mpg commuter car, but with its great looks and Pontiac's plans for high-perf parts, it'll be a hot one. Ford's Escort and Lynx get a turbo for '84, and the all-new Mark VII is slippery as can be with a Cd of 0.38.



MERCURY LYNX TURBO

PONTIAC FIERO



and American Motors in next month's issue. Here's what we've got so far.

Pontiac

The news is the Fiero 2M4, America's first mid-engine sports car. It is probably the most innovative automobile ever mass-produced in America, built by possibly the world's most unique and advanced production process.

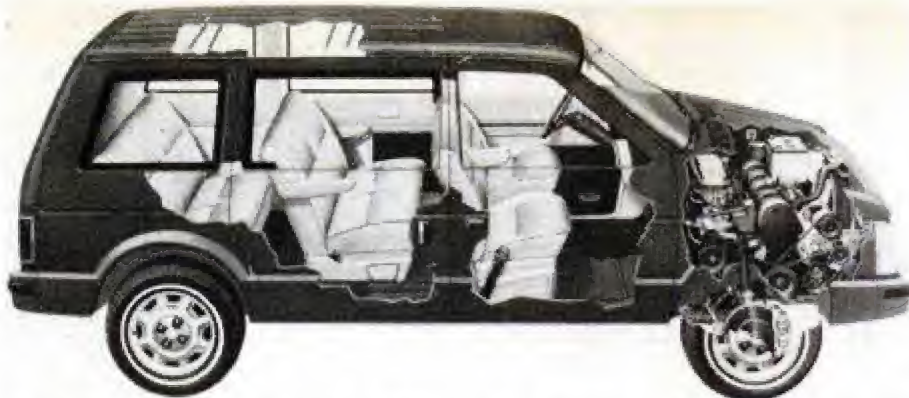
Pontiac Div. managers have been pushing for a two-seater sports car for over 20 years. But there wasn't enough of a market, they said, and Corvette had part of it covered already.

So how is it that nearly two decades later, with the troubled U.S. auto industry just barely beginning to recover from its worst sales slump in modern

history, Pontiac finally has its sports car? Because originally, according to Hulki Aldikacti, the project manager who brought the Fiero to life, the Fiero was proposed to GM management as an inexpensive two-seat economy car. A commuter car. The pinstriped bean counters bought it and the Fiero was on its way.

Surprisingly, the P-car, as it had been designated, began as a front-engine, front-drive design. But that made its nose too long and high. So they turned the fwd power train around 180° and shoved it in behind the seats. This mid-engine configuration also opened the door for much higher performance and handling possibilities.

With visions of mid-engine race cars dancing in their creative heads, Pontiac's project team designed a racer-like structural space frame around a



Fwd Chrysler minivans weigh 3,000 pounds, have a top GVW of 4,600 pounds.

driver and passenger. This not only protects them, but also forms the basis of a unique driveable chassis, independent of the body skins, to which all the suspension, power train and other components are mounted. Much of it is high-strength, lightweight steel, with corrosion-resistant galvanized steel used in key structural areas.

The strut rear suspension is basically the X-car front arrangement, but upgraded to later A-car (Celebrity, 6000, Ciera, Century) specifications. For the front, the GM T-car (Chevette, 1000) upper and lower control-arm front suspension system was chosen for its good geometry and compact, low-profile dimensions. Rack-and-pinion steering to enhance the

steering response and handling, and lightweight, power-assisted, aluminum-caliper disc brakes are fitted at all four corners.

Plastic body skins are used because they don't rust, they're resistant to minor damage, and they're easy to repair or replace. Also, the tooling is cheaper for a relatively low-volume car. The Fiero's horizontal panels—hood, headlamp doors, roof, upper rear quarter panels and decklid—are stiff sheet molded compound (SMC), while its more vulnerable vertical body parts like front and rear fascias, front fenders, doors and lower rear quarters, are flexible, scratch- and dent-resistant, reaction-injection-molded (RIM) urethane.

Because of the car's short tail and

upright rear roof, its drag coefficient, 0.377, is good, but not spectacular. Pontiac's designers experimented with slicker fastback and bubbleback designs, but ran into problems with rear visibility, cooling and engine accessibility. So the design was left pretty much as you see it, except for refinements by chief Pontiac designer John Schinella and his group.

The interior design is aircraft-inspired and driver-oriented, with a free-standing instrument cluster and fingertip location of major controls.

Centered in the easy-service instrument pod are rectangular temperature and fuel gauges flanked by the large, round and easily readable *electric* (no clumsy cables) tachometer and speedometer. A voltmeter sits inside the tach, so all that's missing is an oil-pressure gauge.

Enough background. How does it work?

Styling judgments are subjective, of course, but we think Fiero's looks are superb. It makes Fiat's mid-engine X1/9, which we've always liked, look like a rough-hewn block, puts Mazda's nice but plain RX-7 on the trailer and blows Nissan's overdone 280ZX and Mitsubishi's clumsy Starion clean into the weeds.

On the negative side, what look like quarter windows are really black plas-



CHRYSLER LASER



PLYMOUTH RELIANT



Chrysler Laser and Dodge Daytona are showroom stoppers for '84. Fwd sports cars feature a fuel-injected, turbo-charged 2.2-liter Four rated at 142 hp. Reliant and Aries two-doors, four-doors, wagons have lots new, including Mercedes-like grille.

tic panels, and the lack of any real glass there creates a visibility problem when merging or changing lanes. There's a rear quarter vent for carburetor air on the driver's side, but no matching one on the other flank. The function-oriented Pontiac designers couldn't see installing a fake one. And the pop-up headlamps, which rise to legal height like twin E.T. heads from the ultralow hood, look pretty awful in their up position.

Mechanically, the car that Pontiac cleverly convinced the corporation was a sporty commuter has not quite completed its conversion to serious sports car. Beneath Fiero's smashing body lies a surprisingly good suspension. But behind its seats sits an ancient econocar power train.

It's not Pontiac's fault. The problem lies at GM's corporate headquarters, where shortsighted decision-makers have refused to step up to the need for modern, high-revving engines and decent, five-speed manual transmissions. The old 2.5-liter pushrod Four and lazy-ratioed four-speed were behind the times in the '80 X-cars four years ago. The same combination today is woefully out of date, especially in the high-tech Fiero.

With throttle-body electronic fuel injection and new-for-'84 fast-burn,

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DODGE CHARGER



**CHRYSLER
NEW YORKER
TURBO**



Dodge Charger and Plymouth Turismo are the sporty hatchback coupes based on the fwd Dodge Omni and Plymouth Horizon. For '84, the Charger and Turismo are distinguished by a new quad-headlamp front end and other sheet-metal refinements. The Shelby 2.2 engine and close-ratio five-speed transmission is the hot setup. The Horizon and Omni also get the Shelby power package and optional Rallye cluster with full instrumentation. The Chrysler New Yorker, which is one of the best little luxury packages out of Detroit, receives an extensive array of standard and optional equipment added for '84, including a turbo on the 2.2 EFI Four.

PLYMOUTH HORIZON

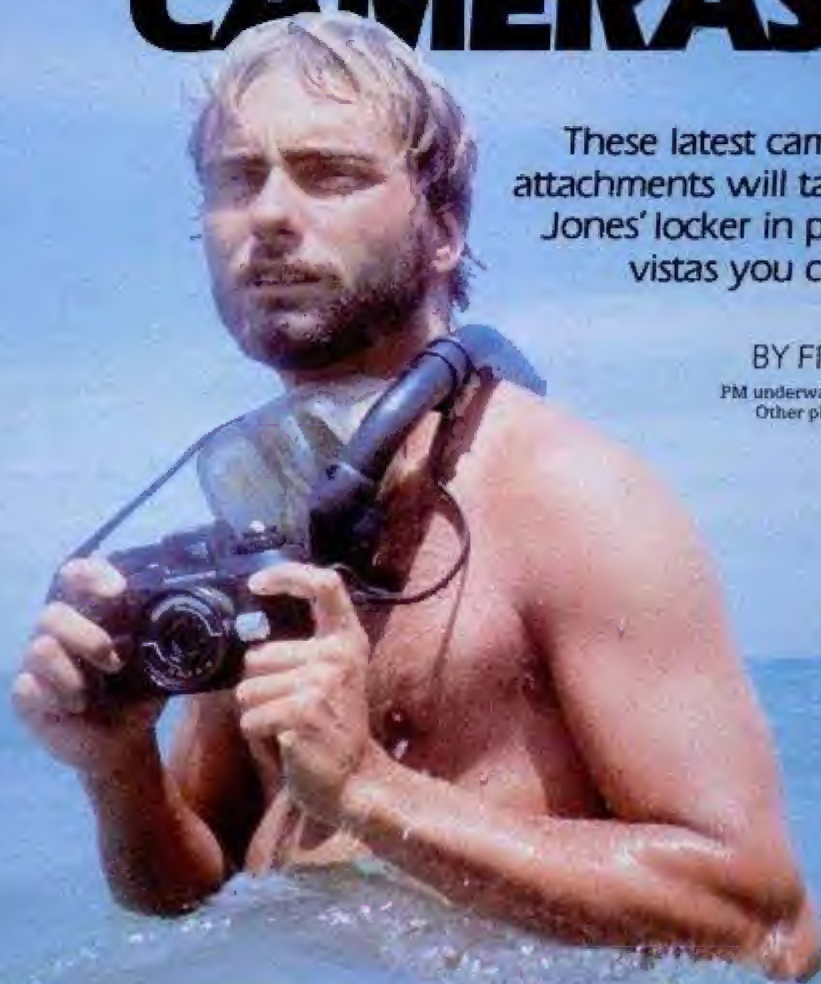


FOCUS ON UNDERWATER CAMERAS

These latest cameras and attachments will take you into Davy Jones' locker in pursuit of new vistas you can capture on film.

BY FRANK LUSK

PM underwater photo: Fred Spiegel
Other photos by the author



Sunpak underwater flash was used along with Nikonos camera (left) to take photo above. Camera and flash combo provide light to show colors.



The Nikonos IV-A has been improved over an earlier model. Hanimex makes an underwater 35mm called the Amphibian, and a waterproof case for the Kodak Disc Camera.

Underwater photography is a more exciting—and accessible—experience than ever before. Two new cameras, a camera housing and an electronic flash will take you deep into the fun of a new world to capture on film.

The cameras are a Nikonos IV-A (vastly improved over earlier model numbers of the Nikonos) and a 35-mm version of Hanimex's popular 110 Amphibian. The housing is from Hanimex for the Kodak Disc Camera. And, Sunpak has released a new flash attachment that will help all these cameras to record true underwater colors.

Nikonos IV-A

Until the introduction of the Nikonos IV-A, Nikon's underwater camera line had hardly changed from one Nikonos model to the next since its inception back in the '50s. It has always been the underwater workhorse of professional and amateur photographers who find its rugged, compact design and extensive line of accessories without equal. Now, it's even better.

The current Nikonos IV-A has automatic stepless shutter speeds from $\frac{1}{50}$ to $\frac{1}{1000}$ of a second. The larger high-eyepoint viewfinder is centered over the lens to reduce parallax, and film advance has been modified to operate like that on above-water cameras.

Nikon also has done away with the old, clumsy way of changing film, which involved first removing the lens and then literally removing the guts of the camera from its outer shell. The new model incorporates a hinged back which is both tightened and locked with a simple latching mechanism. There are 15-, 28-, 35- and 80-mm lenses



Hanimex Penguin (also called Wet 'N Dry Housing) seals the Kodak Disc Camera.

available, with the latter two optically corrected for shooting both in and out of the water. An automatic flash unit, close-up attachments and many other accessories also are available.

Non-Nikon accessories also can be used with the Nikonos IV-A, and among the extras is an underwater strobe made by Sunpak (the Marine 32 model). It lacks the automation of the Nikon flash, but it has many similar features, including a built-in slave and impressive power.

Hanimex 35 Amphibian

Like the Nikonos IV-A, the Hanimex 35 Amphibian is a true underwater camera, designed to withstand water pressure to a depth of 50 meters. Similar in appearance and operation to its little brother, the 110 Amphibian, the new model offers 35-mm film quality in a package only slightly larger.

Built into its rugged orange body are features such as auto-exposure, motorized film advance and a built-in flash.

Sunpak Marine 32 (left) lets you take flash shots with underwater cameras. The new back on the Nikonos IV-A (right) is hinged for easier film changing. Hanimex's 35 Amphibian (below) has a built-in flash and easy-to-grip controls.



Its 35-mm f2.8 lens may be focused from 3 feet to infinity and stopped down to f22 using large, easily gripped controls on the front of the camera. The 35 Amphibian may not be the system camera that the Nikonos is, but it's very attractive for the price.

Hanimex Penguin

While there's nothing new about underwater camera housings, dropping one of Kodak's remarkable little Disc Cameras into one creates an underwater unit that's too much fun to be overlooked. I would guess that anyone over the age of 5 could take perfectly exposed pictures. The Hanimex underwater housing retains the Disc Camera's one-button operation and may be used to a depth of 4 meters. The camera features a four-element 12.5-mm glass lens which is prefocused to provide good image sharpness from 4 feet to infinity. Exposure, film advance and flash operation are all automatic. The camera and housing float so you can find the unit the next time you dump yourself out of a canoe.

A recent trip to the Florida Keys gave

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30 DAYS WITH HERO-1

The new Heath Educational Robot One turns out to be a personable member of the family.

BY NEIL SHAPIRO ELECTRONICS EDITOR

"Daddy, is HERO going to come back home?" my 4-year-old daughter asked. Tears welled in her eyes as I loaded the robot into a car bound for the photographer's studio. I assured her that her new playmate would return and reflected that it was true — HERO-1 wasn't just a computer on wheels, he was already a member of the family.

They say all newborns look alike, but when HERO-1 (or the Heath Educational Robot One) arrived — in two large boxes filled with everything from gears to chips, along with a thick assembly manual — he was less than beautiful. However, he went together faster than I thought he would. While he was no clock radio in simplicity, I found his step-by-step manual easy to follow. In less than two weeks of partial evenings, there he stood — a baby robot with cute little tubular eyes, tiny hand ever ready to grasp your finger, little forehead wrinkled with buttons and a pleasant, ready-to-learn attitude.

I flicked the button to ON and HERO responded with "Ready." And ever since then, he has done his best to fit in with our family.

Hero's little brain (pardon me for not capitalizing his name any longer, it just doesn't seem like the little guy's style), which is a 6808 microprocessor with 4K of RAM, quickly began to catch on to the world around him, with a little help from his programming parent. Actually, programming Hero is far easier than getting most kids to listen to their parents. In fact, even if you've never programmed a computer, it will probably be easy to get your own robot to follow your commands.

There are three methods of programming Hero. The first, and most complex, is called assembly language. The next, not much harder than using a BASIC-style computer language (although it uses numbers entered via the forehead keypad rather than words), is what Heath calls "robot language." And, finally, he

(Please turn to page 141)

A keypad on HERO-1's forehead lets you enter a program into his on-board computer. He can be programmed in assembly language or in an easy-to-master "robot language."



Roughly 2 million Americans will buy binoculars this year, and that's just how most of them will do it—roughly. With hundreds of models to choose from, more than 20 makes, weights ranging from a few ounces to too heavy to hold, and sophisticated optical designs—not to mention pricing from a few dollars to hundreds—it's easy to become confused. Here's what you need to know to eliminate that confusion.

Binoculars come in two basic designs: porro prism and roof prism. Prisms are polished glass reflectors that bounce the light around inside the binocular barrel so the image you see is right-side up and correct from left to right.

Porro prisms produce the familiar offset binocular

shape. Roof prisms allow straight barrels.

Close-up viewing ability may not be fully appreciated in a long-distance instrument like binoculars until you try it. It's great for spotting fine details in fenced-off objects in museums or other restricted areas. Short-range sharpness can vary slightly from sample to sample and greatly from line to line or maker to maker. Less expensive models often won't focus closer than 20 feet. Higher quality glasses sometimes range down to 10 feet or less.

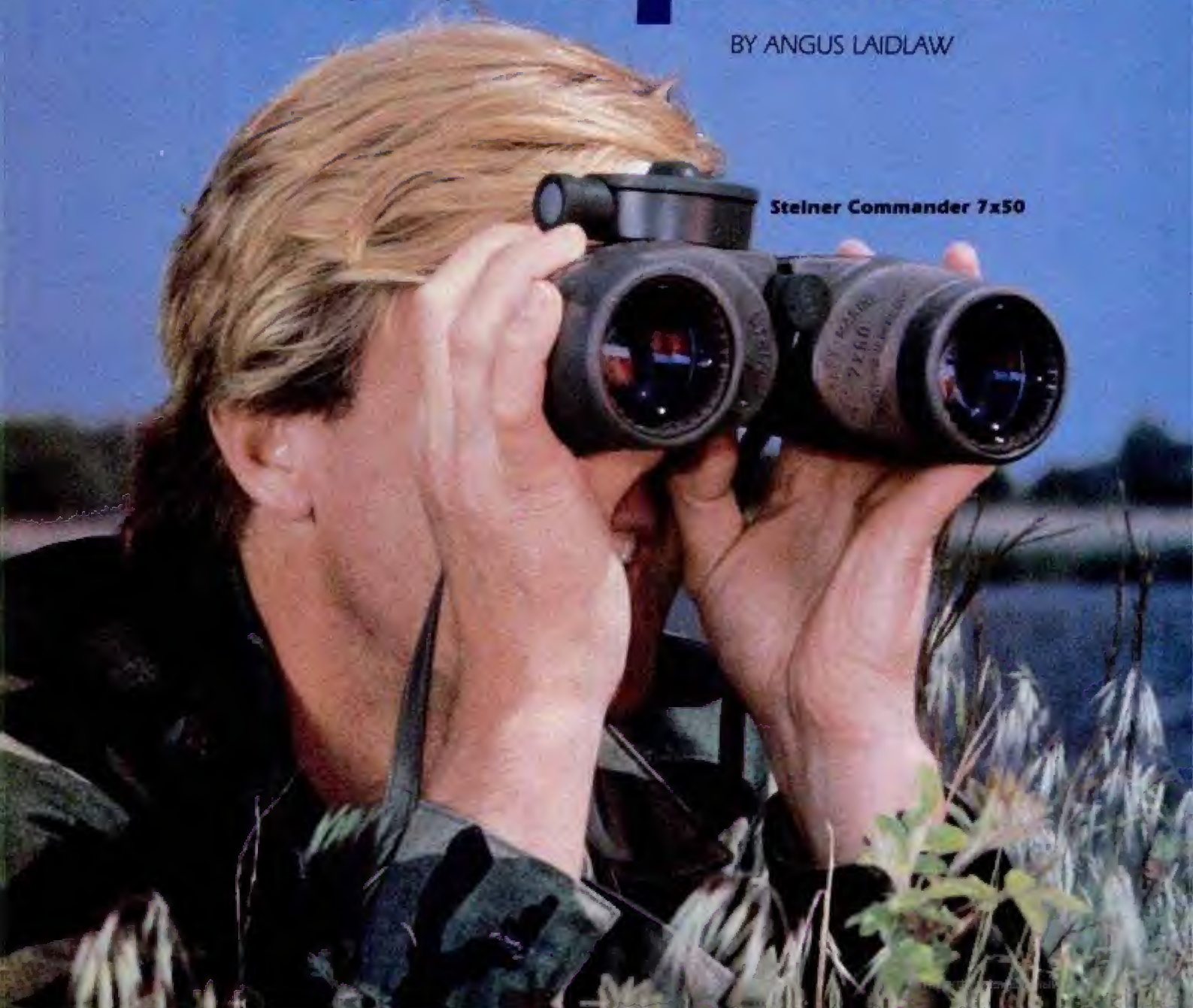
Focusing a sharp image works two ways: center focus (CF) by wheel or lever and individual focus (IF) for each barrel at the eyepiece. Center focusing is much more convenient and we strongly prefer it. It's harder to seal a glass with central focus-

The World Up Close

We make it easy to choose
the binoculars that'll do
the job for you.

BY ANGUS LAIDLAW

Steiner Commander 7x50



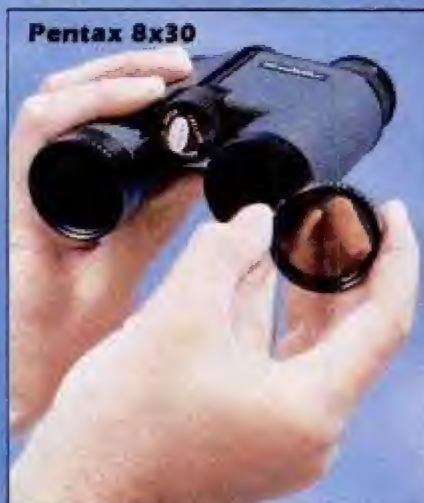
ing, so almost all the waterproof models have IF. Some of the best of these, often military or military-derived designs, have great depth of field so everything from 30 feet to infinity will be sharp.

Most binoculars with central focusing have some provision for adjusting focus to accommodate the difference between your eyes. Usually the right eyepiece can be turned, though some models have a second central adjustment for one barrel or the other.

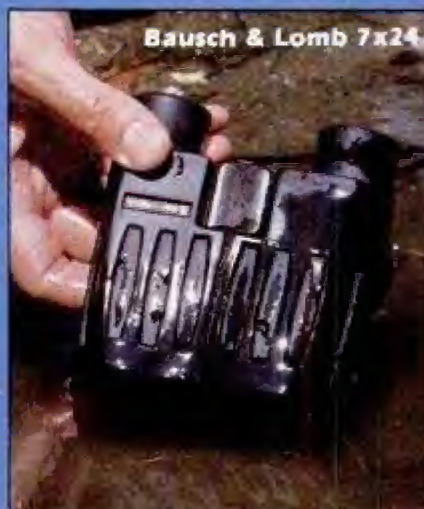
Many less expensive models use a sliding lever instead of a finger wheel for fast focusing. This works quickly but is easier to knock out of focus than a finger wheel.

Compasses and reticles, usually in the right lens

Below, Tasco 15x50 is surprisingly small considering its magnification capabilities. J.C. Penney 7-15x35 lets you zoom in for up-close viewing for \$85. Minolta 6x20 has reversed porro prisms, resulting in the objective lenses being farther apart than the eye lenses. Rubber-armored models range from \$127.50 (Apollo 8x21) through \$149.95 (Apollo 8x56), \$350 (Almpoint 8x30), \$449 (Steiner 7x50 Commander with illuminated compass), \$427 (Nikon 8x30) to \$800 (Swarovski Habicht SL 7x40).



Pentax 8x30 DCF Premium (top left) offers colored and polarizing filters to cut glare. The polarizing filter reduces glare in bright sunlight. A yellow filter improves contrast of distant hazy objects, and a brown filter is useful for cutting down the sun's intensity on a bright day. Bausch & Lomb Discoverer 7x24 (lower left) is armored, fogproof and waterproof at \$300. Waterproof binoculars are a good idea if you'll be viewing under wet conditions. Armored binocs aren't impervious to all impacts, but can be more impact-resistant than nonarmored models. Armor coating is also a plus for hunters who wish to remain quiet. It doesn't make a loud noise if it's brushed against a twig or a rock.



PM photos: Lou Jawitz



only, are offered by some military-derived or government-spec binoculars. The compass reads in degrees and some, like the Steiner, can be illuminated by pushing a button. A compass adds bulk and complexity, but telling someone to look for an object at 163° works a lot better than pointing vaguely and saying, "over there."

Reticles in the form of thin vertical and/or horizontal markings, similar to the cross hairs in a telescopic sight, are graduated. Designed to help estimate ranges to objects of known sizes, they are often hard to use, difficult to see in dim light and may be more lens clutter and trouble than they are worth to casual users.

Rubber armor coatings have become popular recently. They come in colors, mostly camouflage green, mottled camouflage, marine yellow and black. Rubber armor protects binoculars from minor dings, makes them easier to grip, keeps them from sliding around when you put them down, protects them in wet weather and helps make them silent to carry and use. Silence counts especially for hunters and bird watchers. Some Pentax models have removable or optional armor, but most armor is permanent.

Waterproof glasses that claim to have been tested to a certain depth, usually 30 feet, are the only ones really sealed against immersion. Water-resis-

tant binoculars shouldn't absorb water when rain-sprinkled or spray-splashed, but will leak if they're dunked. These are the features you look for in any binoculars.

All binoculars are labeled with two numbers separated by an \times , such as 7×35 . The first number is the power or magnification of the binoculars. It tells you how much closer an object will appear. A $7\times$ binocular makes something 70 feet away appear to be only 10 feet off. The second number is the diameter of the objective lens in millimeters. This tells you how big the binocular is and gives you a clue to its light-gathering ability and weight. The bigger the objective, the more light it gathers and the better you see at night or in dim light.

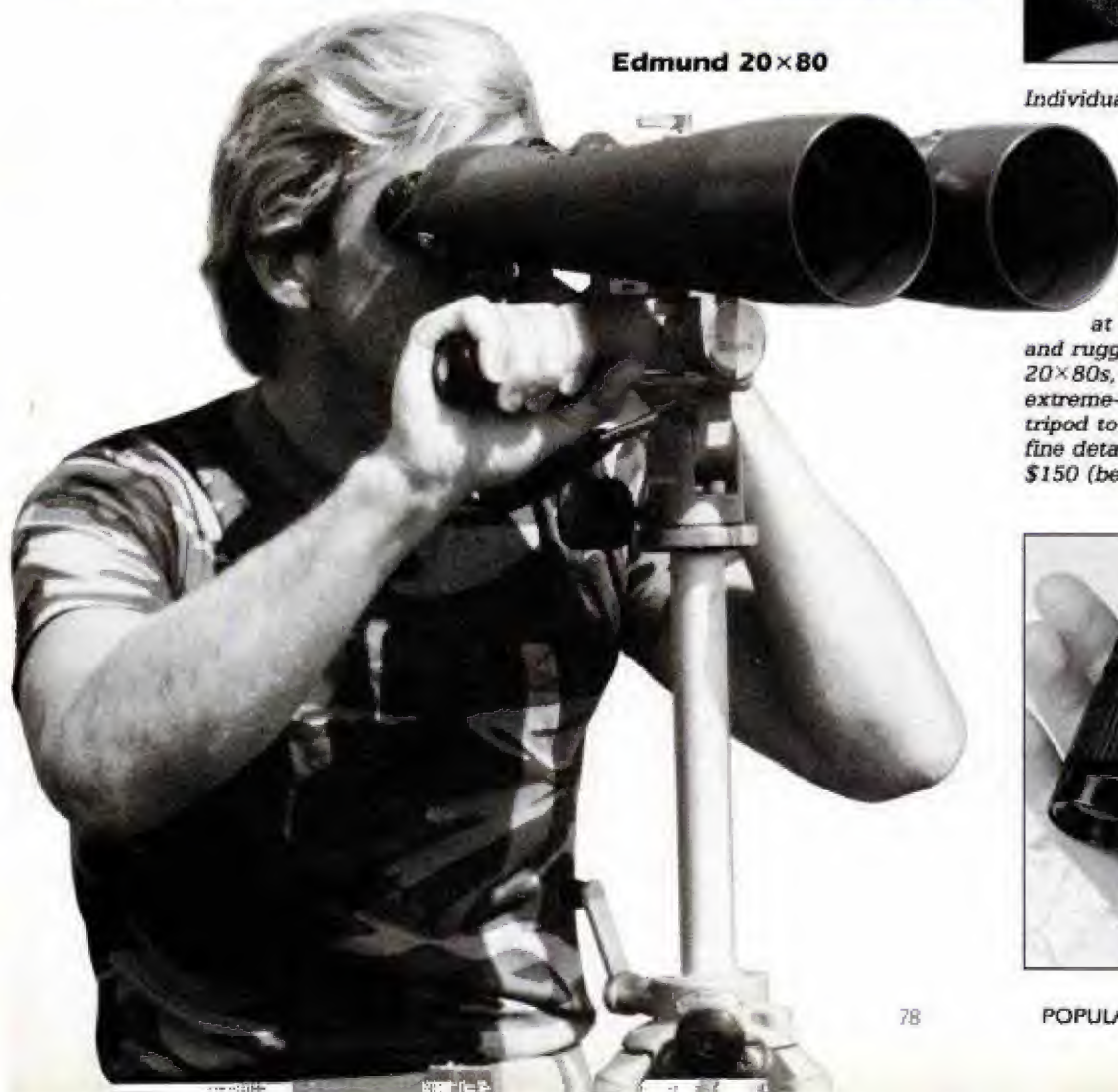
Dividing the power into the objective lens diameter tells you the size of the exit pupil (the circle of light in the eyepiece lenses of the instrument). In bright light, the pupil in your eye contracts to about 2.5 mm and can't use any more light. That's why large-pupil night glasses produce images no brighter than smaller-lensed minis in daylight. At night, though, your pupil expands to about 7 mm so it can accept most of the light gathered by a 7×50 's 7-mm exit pupil.

A larger exit pupil can also be an advantage because it makes it easier to

(Please turn to page 138)



Edmund 20x80



Individual focus on Nikon 8x30 (top) is easier to use with scale, also helpful when printed on hinge for eye-spacing adjustment. Folding rubber eyecups (center, above) on Tasco 15x50 Micron aid eyeglass wearers. Zoom on J.C. Penney 7-15x35s increases versatility at the expense of optical qualities and ruggedness. Edmund Scientific's 20x80s, \$400 (left), are great for extreme-range work, but require a tripod to hold them steady to discern fine detail. Micros, like Brunton 6x16, \$150 (below), go anywhere, work well.



PM OWNERS REPORT:

BY MICHAEL LAMM WEST COAST EDITOR

FORD THUNDERBIRD

"Functional interior and excellent electronics"

FLORIDA HOUSEWIFE

"Trunk's too small."

MICHIGAN RETIREE

"It's easy handling, has smooth ride and is very comfortable and stylish"

NEW YORK
INTERIOR DESIGNER



"The V6 engine is not powerful enough."

OHIO AUDIT MANAGER

"Shoddy interior, details and workmanship bug me."

FLORIDA FIREFIGHTER

"I wish that more Americans would try a T-Bird before buying an imported car."

NEW YORK
SCHOOL ADMINISTRATOR

Almost half of these T-Bird owners have no gripes—a record in our surveys.

Ford had it right 28 years ago with the first T-Bird, and now a lot of folks believe Ford's got it right again. Recent buyers of the '83 feel strongly that the T-Bird turned out very right in three important areas: styling, workmanship and freedom from repair.

We've rarely noted greater enthusiasm for a new-car design. And whatever you think of the 1983 Thunderbird styling, over 77 percent of the car's buyers told us they bought their Birds for one primary reason: *appearance*.

A North Carolina enlisted man, for example, commented, "... the 1983 Thunderbird will someday become a classic like the 1955-57 because of its good body design."

PM photos: Bill Ashe

A Massachusetts policeman concurred. "I've been an avid T-Bird fan since the late 1950s, but stopped buying them after 1966 because they were becoming big, nondescript boats. The '83 appears to be a return to the classic days."

A Georgia airline pilot rhapsodized, "Styling is magnificent. The car's a real head-turner."

**A NATIONWIDE SURVEY
BASED ON 637,964
OWNER-DRIVEN MILES**

An Ohio office manager echoed, "Everywhere I go people are always com-
(Please turn to page 176)



The new Thunderbird styling is dazzling from any angle, say those who bought car.



Cabinets That Make A Room

Shop-built cabinets are the focal point in this room. The doors feature strips of wood arranged in chevron fashion.

BY PAUL LEVINE

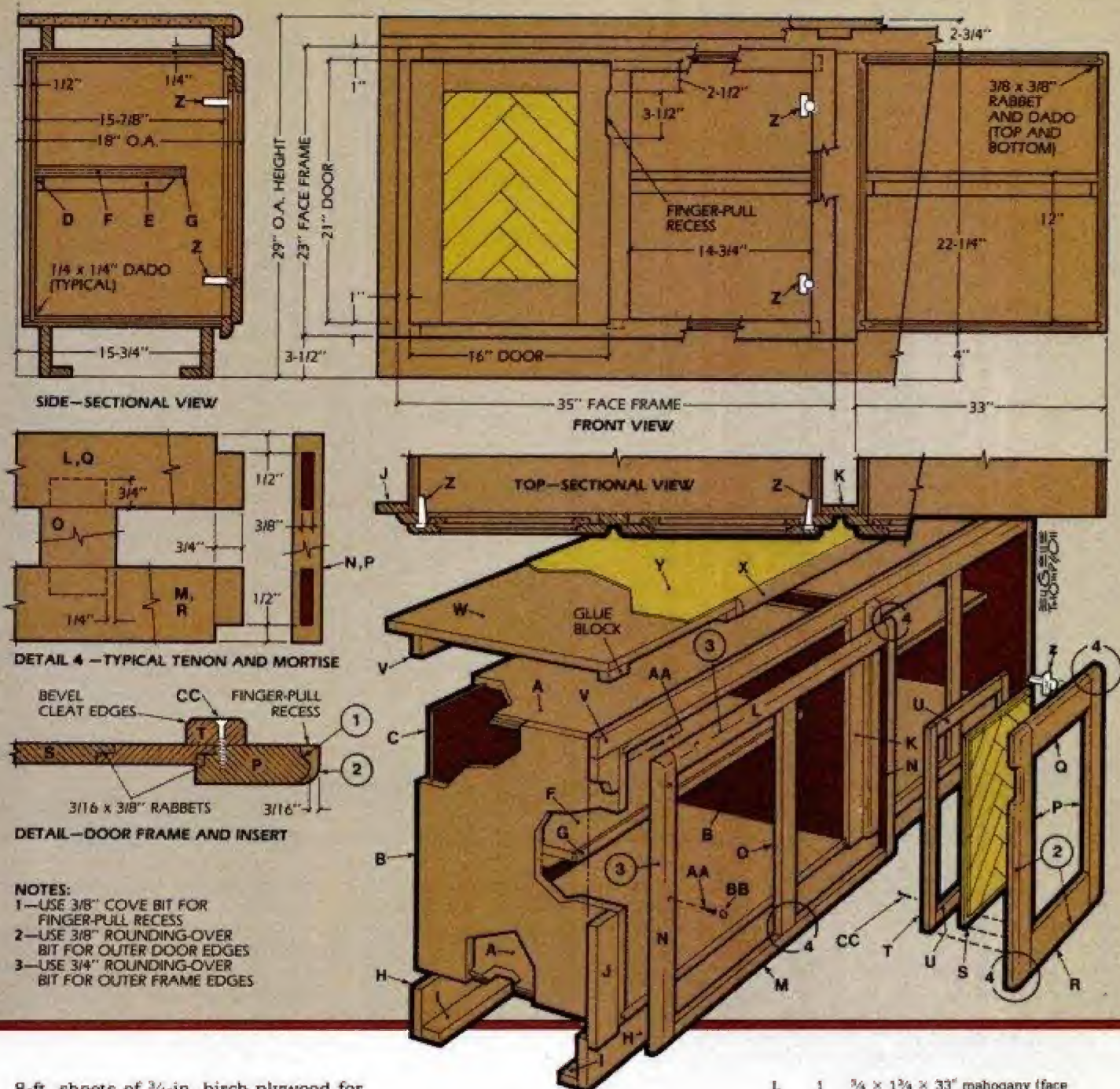
To make our living room multifunctional, I elevated one end and banked the walls with custom-designed cabinets and drawers. Now the space serves as a dining room and study. It provides the effect of a separate room, yet has a spacious feeling that's not

constrained by a dividing partition.

Your first step should be to decide on the number of cabinets the room requires, and then figure out what materials you'll need to buy. I built three cabinets to fit along one wall. To make three cabinets, you need two 4 ×



L-shaped counter with handsome cabinets and drawers (top) was designed to give this room a variety of uses. The cabinets store tableware and linens, while the drawers (above) hold paper and office items. The drawers are assembled with dovetail joints, which are made with a router and dovetail fixture.



8-ft. sheets of 3/4-in. birch plywood for the tops, bottoms and sides. Use 1/4-in. birch plywood for the back.

Cut the 3/4-in. sheets into three equal strips 15 7/8 in. x 8 ft. Cut the tops and bottoms (A), and the sides (B). Use a table saw or router to cut rabbets on the tops and bottoms. Cut dadoes in the sides. Be sure to wear eye protection.

A 1/4-in. groove at the back inside edge of each piece receives the plywood back (C). Join all members with carpenter's glue. Cut and install the shelf cleats (D, E) and the shelf (F) with its edging (G).

The face framework for each cabinet is of mahogany. Cut the frame parts (L, M, N, O) to size. Members form a mortise and tenon joint (see the detail in the drawing). To cut tenons in L, M and O, measure the 3/4-in. length of the tenon and mark its shoulder around each piece. Carefully lay out and mark the 3/4-in. tenon thickness. Mark the width

MATERIALS LIST—DOOR CABINET

Key	No.	Size and description (use)
A	2	3/4 x 15 7/8 x 32 1/4 birch plywood (top, bottom)
B	2	3/4 x 15 7/8 x 22 1/4 birch plywood (sides)
C	1	1/4 x 21 3/4 x 32 birch plywood (back)
D	1	3/4 x 1 x 31 1/4 birch plywood (shelf cleat)
E	2	3/4 x 1 x 10 birch plywood (shelf cleats)
F	1	3/4 x 12 x 31 1/4 birch plywood (shelf)
G	1	1/4 x 3/4 x 31 1/4 birch veneer (shelf edging)
H	2	3/4 x 4 x to fit mahogany (floor base)
I	2	3/4 x 2 x to fit birch plywood (floor cleats)
J	2	3/4 x 2 1/2 x 22 3/4 mahogany (end spacers)
K	2	3/4 x 3 (or to fit) x 22 3/4 mahogany (spacers)

PM color photos: George Ancona; black and white photos by the author

Technical art: Eugene Thompson

Room stylist: Gabe Herrick

Accessories: Conran's, New York, N.Y.

L	1	3/4 x 1 1/4 x 33 mahogany (face frame, top rail)
M	1	3/4 x 1 1/4 x 33 mahogany (face frame, bottom rail)
N	2	3/4 x 1 1/4 x 23 mahogany (end stiles)
O	1	3/4 x 2 x 21 1/2 mahogany (center stile)
P	4	3/4 x 2 1/2 x 21 mahogany (door stiles)
Q	2	3/4 x 2 1/2 x 12 1/2 mahogany (top door rails)
R	2	3/4 x 3 1/2 x 12 1/2 mahogany (bottom door rails)
S	2	3/4 x 11 3/4 x 15 3/4 overall, apple, cut into 3/4 x 2 1/2 slats (cabinet door inserts)
T	4	1/2 x 1 1/4 x 17 1/4 mahogany (vertical battens)
U	4	1/2 x 1 1/4 x 10 3/4 mahogany (horizontal battens)
V	2	3/4 x 2 1/2 x to fit mahogany (counter rails)
W	1	3/4 x 18 x to fit particleboard (counter)
X	1	3/4 x 1 1/2 half-round bullnose mahogany (trim)
Y	1	18 x to fit plastic laminate
Z	2 pr.	Grass No. 1200 concealed hinges*
AA	**	2" No. 10 flathead wood screws
BB	**	Wood plugs
CC	**	1" No. 8 flathead wood screws

Misc.: Carpenter's glue, Watco penetrating oil or other finish.

*Grass America Inc., Box 1019, Kernersville, N.C. 27284.

**As required.



Three cabinets with face frames rest on the floor toekick along one wall in the room. The vertical mahogany fillers are installed between each one of the cabinet units.

bottom and the lighter ones above. The slats are rabbeted and lap joined. Joint the slat edges and finish-sand with 220-grit paper before gluing them together with carpenter's glue.

Cover each glued insert panel with a sheet of wax paper and $\frac{3}{4}$ -in. plywood, and leave them overnight. Next, trim the insert square and rabbet the edges. Then sand the new corners and slightly round the edges. After finishing the doors (as described later), position the inserts in the frames. Secure them with battens (T, U). Do not glue the inserts in place or they'll buckle and break.

Finishing the cabinets

The finishing method here is fast and easy. You can achieve spectacular results the first time. First, sand the wood with successively finer grits of paper, beginning with 80-grit and ending with 220. Next, flood the surface with Watco penetrating oil. After the oil has penetrated, leaving a light film on the surface, use an orbital sander such as Rockwell's Model 330 Speed-Bloc finishing sander with felt pad base and 400-grit wet or dry silicon carbide paper. Sand the wet surface, adding fresh oil as needed to keep the surface wet.

This sander's high rpm ensures a silky-smooth finish. Use this method in a well-ventilated room, and take precautions for working with a flammable material.

After sanding and finishing, mount the cabinets in place on a base and cleats (H, I). Cut spacers (fillers J, K) of mahogany and fasten them in place with screws through the cabinet stiles. The fillers should be flush with the face frame at the top and extend slightly beyond the toekick below.

Install the doors using Grass No. 1200 or other concealed hinges (Z). Lay out and cut the door stile as needed for the door-hinge member. Locate and screw the hinge plate to the cabinet side wall. Adjust the doors as needed by tightening and loosening the adjustment screws.



After wood slats are glued up (above), insert dimensions are marked and panel is cut out. Next: Rabbet the edges.

A view of door back (right) shows finger pull, battens holding door panel and concealed hinge on the door stile.

At this point, you can add the top rails (V) to the entire assembly and install the countertop (W), according to the directions at the end of the story. However, if you are building cabinets with drawers, begin work on these and add the countertop when all units are in position.

The cabinets that contain drawers are constructed in the same fashion as the cabinets with doors. However, the interior sides which are visible (see rightside view in drawing) are made up of rails (D, see materials list) and stiles (C) with decorative inserts (E) that are fastened by cleats (G). These sides define a kneehole area so the counter can be used as a desk.

The drawers are assembled with dovetailed corners. I made them using a Sears (No. 9GT2574) template and a $\frac{1}{2}$ -in. dovetail cutter in a router. Rout the groove for the bottom member (P) in the sides and back of the drawer. Round over the edges of the drawer with a $\frac{3}{8}$ -in. rounding-over bit. *Note:* Do not round over the false-front edges that abut the drawer front.

Cut the drawer fronts (Q) and drawer pulls (R). Round over the front edges with a $\frac{3}{8}$ -in. rounding-over bit. Glue and screw the front to the drawer (false



Door frame is smoothed by 400-grit wet/dry silicon carbide paper on orbital sander. Watco penetrating oil finish is next.



front). Apply finish to the cabinet and the drawers as previously described. Then mount the drawers with Grant full-extension slides (S), No. 555 or 557, or use other hardware. Install spacers (U) as needed and mount the cabinets in place on the base (toekick). Install the counter rails (T) to receive the counter.

Making the countertop

Cut out the countertop and laminate it. I used WilsonArt's solid beige plastic laminate, No. 1530-6. (For tips on laminating, see *Tile Or Laminate Countertop? Here's How To Do Both*, page 102, Feb. '83). Be sure to cut the laminate about $\frac{1}{4}$ -in. larger than the countertop's length and width. Trim it later, after it's bonded.

The $1\frac{1}{2}$ -in. bullnose molding was bought at a lumberyard. But you can make your own molding using $1\frac{3}{16} \times 1\frac{1}{2}$ -in. mahogany and a $\frac{3}{4}$ -in. rounding-over bit in a router. Glue the molding on and reinforce the joint with glue blocks below.

When you install the countertop, it helps to have an assistant. If you must make the counter in two parts, you can pull the joint together with Tite joint fasteners.

PM

Build PM's MUSIC BOX

Quality stereo equipment deserves to be shown off in style. Our rack-type cabinet does just that.

BY DAVID DECRISTOFORO

PM black-and-white photos by the author

Owning a multicomponent home stereo system creates one immediate problem—where do you store all the components? The current solution to this problem is the stereo rack—a cabinet which stacks stereo components on shelves vertically. Unfortunately, many store-bought stereo cabinets rely on a

high-tech facade (veneer or laminate) to hide inferior materials and workmanship. But here's an alternative: Use our plans to build your own solid oak rack-style stereo cabinet.

Before starting construction, measure your stereo equipment to ensure that our cabinet will accommo-



Trim the side radii cutouts using a router fitted with a $\frac{1}{8}$ -in. guide bushing. Guide the bushing against a plywood template in order to control the cutter.



With the side frames dry-assembled, rout the panel grooves with a $\frac{1}{4} \times \frac{1}{8}$ -in. slotting cutter. Then, shape the frame opening's edge using a $\frac{1}{2}$ -in. rounding-over bit. Also mark the dowel locations at each joint before disassembling.



Rout the stopped dados for the shelves and the cabinet back with a $\frac{1}{4}$ -in. straight bit. You must clamp a straightedge in place to guide the router. Be certain that the bit cuts into the frame members only and not into the side panels.



Assemble the cabinet with glue and then clamp it square. Use glue sparingly to avoid excess squeeze-out. Secure the shelves with screws turned into the cabinet's sides. Conceal the screwheads with $\frac{3}{8}$ -in.-dia. walnut plugs.



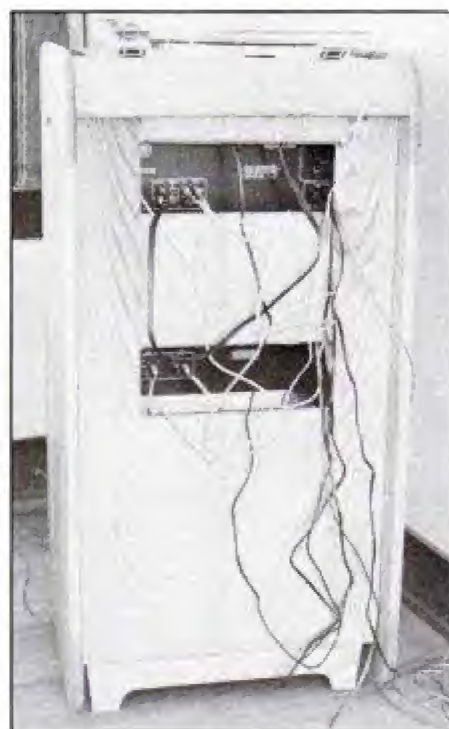
Glue and clamp the three cove pieces in a plywood jig. Cut joining edges at $22\frac{1}{4}^\circ$ angles. The top board serves as a clamping block to ensure even pressure.



First use a bench plane to round the cove's outside surface. Then, finish-sand to remove all of the planing marks.



Notch drawer front to match the shelf edge detail and to serve as drawer pulls. Join sides to front with dovetail joints.



The cabinet back is designed to allow easy wiring among components. Also notice that the back is recessed for additional space to store excess wire.

date it. Our cabinet is designed to accept many standard-size components, but you may have to alter sizes for your equipment.

Begin by building the cabinet sides. Each side consists of a frame with a solid panel insert. Cut the frame pieces. Notice that the top and bottom pieces are 2 in. wider than the sides. This is to allow for the inside radius cutouts. To make the radius cutouts, first pencil the cutout profile on the frame top and bottom pieces. Then, rough-cut the waste using a band saw or sabre saw. Next, make a $\frac{1}{4}$ -in. plywood template $\frac{1}{2}$ in. wider and $\frac{1}{2}$ in. longer than the desired cutout. Clamp the template in place as shown.

Now, use a router fitted with a $\frac{1}{2}$ -in. guide bushing and a $\frac{1}{4}$ -in. straight bit to smooth the cutout's rough inside edge. Steer the bushing against the template's edge to control the bit.

Next, dry-assemble the two frames with bar or pipe clamps. Using a router fitted with a $\frac{1}{4} \times \frac{9}{16}$ -in. slotting cutter, groove the inside edge of both frames for installing the side panels. Then, round the inside frame edges with a $\frac{1}{2}$ -in. rounding-over bit. Also, mark the dowel locations at both of the frames' four joints. Disassemble the frames and use a drill press or a doweling jig to bore $\frac{3}{8}$ -in.-dia. \times $1\frac{1}{2}$ -in.-deep holes at these locations. Before reassembling the frames,



The contemporary oak cabinet provides storage space that's custom fitted to your audio equipment plus a tape drawer and shelves for components and records.

PM color photo: Doc Kominski

Now, make the cabinet shelves. Form the top and bottom shelves by edge-

After the glue has dried on the cabinet sides, cut the outside corners round as shown. Sand all surfaces of both

Now, using the same router setup,
(Please turn to page 142)

K	1	3/4 x 3 3/4 x 19 3/4" oak (drawer back)
L	1	3/4 x 15 x 19 3/4" oak veneer plywood (drawer bottom)
M	2	3/4 x 4 x 16" oak (base front and back)
N	2	3/4 x 2 x 11 3/4" oak (base stretcher)
O	28	1 1/4" No. 8 fh screw
P	28	3/8"-dia. x 3/8" walnut plug
Q	4	1 1/2" No. 8 rh screw

Misc.: Carpenter's glue, Watco Danish oil finish, 600-grit wet/dry abrasive paper, paste wax.
*Trim to fit.



If You'd Rather Buy...

Not everyone has the desire to build his own stereo cabinet. There are two remaining options: You can buy a ready-made unit at a department store or hi-fi showroom, or you can have a cabinet shop custom-build a piece to suit your taste and budget. For cost reasons, the first option is the most popular.

If you're thinking of buying a ready-made cabinet, here are some points worth considering. Most store-bought units come in knocked-down (KD) form—but don't let this stop you. Assembly is usually easy and can often be done with a screwdriver.



The Classic Elegance Model CE1280 (\$399.95) from Bush Industries, 312 Fair Oak St., Little Valley, N.Y. 14755, is a total entertainment center. Features include space for a 19-in. TV, a rollout video recorder shelf and a four-component audio section behind glass doors. It's finished in oak vinyl veneer.



Custom Woodwork and Design Inc., 7447 South Sayre Ave., Bedford Park, Ill. 60638, offers a wide variety of modular cabinets that can be grouped to suit your audio/video needs. Included in the unit shown (\$2,000) is the new wine rack accessory. The cabinets are available in either oak or walnut.

Also, a KD cabinet fits into most cars, saving you delivery charges.

To keep costs down, most cabinets are built of particleboard which is veneered with an imitation wood-grain vinyl, a genuine wood veneer or high-pressure plastic laminate, depending upon furniture quality. Although 3/4-in.-thick particleboard is suitable for cabinet construction, 3/8- or 1/2-in.-thick particleboard should be avoided, especially if the maker uses it for shelving. A better choice (at a slightly higher price) is a solid wood and/or wood veneer plywood cabinet.

You should buy the best cabinet you can afford and avoid bargain-priced units. When evaluating a prospective cabinet, make certain there's enough space between the shelves not only to house your components, but to allow for proper ventilation.

Cabinets with tempered glass doors are available for a more attractive, neater storage system. The doors also prevent dust from settling on the equipment. Many smaller cabinets are set on casters. This permits the cabinet to be moved easily.

You may want to choose a furniture line that offers a building block system via modular cabinets. Then, as



The Crestwood Model SK-3GT (\$492) solid red oak stereo cabinet from Sunrise Audio Systems, 13622 Northeast 20th, Suite F, Bellevue, Wash. 98005, features a lift-up glass top for accessibility to the turntable or VCR unit. Two additional shelves can accommodate another four components.

your audio/video system grows, you can purchase additional cabinets.

If, after shopping around, you can't find ready-made cabinetry to suit your needs, visit a custom woodworking shop. Such shops will build exactly what you desire in your choice of design, materials and finish.

In most cases, custom-made cabinets cost considerably more than store-bought units. But some shops are surprisingly affordable. Keep in mind that a custom-made cabinet can be ordered unfinished, allowing you to do the finishing yourself to keep down the cost.—Fred Petras



This compact unit conceals audio components and records behind burled veneered doors. Videotapes and video disks are behind two glass doors. At top right, a plastic canopy protects a video recorder or turntable. It's Model 2980 (\$372) from the Gusdorf Corp., 6900 Manchester, St. Louis, Mo. 63143.



Owners of reel-to-reel tape recorders or those with heavy audio/video equipment should consider the Model 140 (\$799) by Wambold Marker, 21101 Superior St., Chatsworth, Calif. 91311. The maker claims that each fixed shelf holds up to 350 pounds, while adjustable shelves hold 175 pounds each.

WORKSHOP MINICOURSE



Spray painting with canned paint

Only those who are into heavy workshopping and around-the-house repair and painting have very good reason for buying sophisticated paint spraying equipment. Though the equipment is expensive to acquire, over a number of projects the cash outlay will be amortized in time saved and the ability to purchase paints by the gallon, a considerable savings.

Most of us, however, will never have the need for elaborate equipment, no matter how great the advantages. When we want a spray finish, we pick paints that come in a spray-type can. Nowadays, these paints and finishes do not contain the aerosol propellants (fluorocarbons) that some feel to be damaging to the ozone layer of the atmosphere.

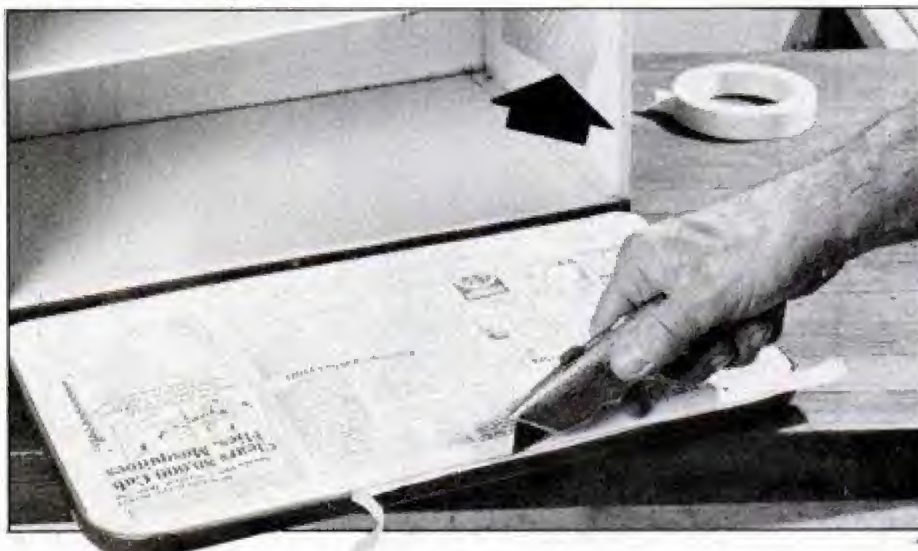
The major argument against a spray can is that it's an expensive way to buy paint. There's no debate about that. Thus, for large projects they are impractical. However, for a small one- or two-can job they are—in my opinion—indispensable.

Spray can paints come in an almost unbelievable variety of finishes, colors and types which permit a homeowner to tackle any around-the-home paint job he may encounter. And, happily, with a little practice you can get very professional-looking results with paints and varnishes from spray cans.

Getting ready to spray

If weather permits, I do as much surface preparation and painting out of doors as I can. This way, the dust from sanding and the fumes from the spray are quickly dissipated into the air. If you do paint outside, however, take a few precautions:

1. If necessary, hang an old sheet or use a piece of scrap plywood—as a backstop to catch all overspray.
2. Make certain you are set up so that none of your overspray infringes upon your neighbor's rights. You don't want to paint any of his property.
3. Don't try to spray paint outdoors on a windy day.
4. If spraying inside, open at least one shop window and turn on the exhaust fan, if you have one.
5. Wear a respiratory mask.



1 Using newspapers and masking tape, mask off areas not to be painted. On this breadbox we decided to leave interior as is. Note tape over vent holes (arrow).



2 Next, smooth surface with sandpaper around backup block. Here, with smooth surface, we used 150 grit.



3 Brush off the residue or else use a vacuum to keep down the dust.



4 Final step before applying paint is to wipe surface with a tack cloth.

Preparing a surface for spray painting is exactly the same as for painting with a brush or roller. Get the surface to the degree of desired smoothness

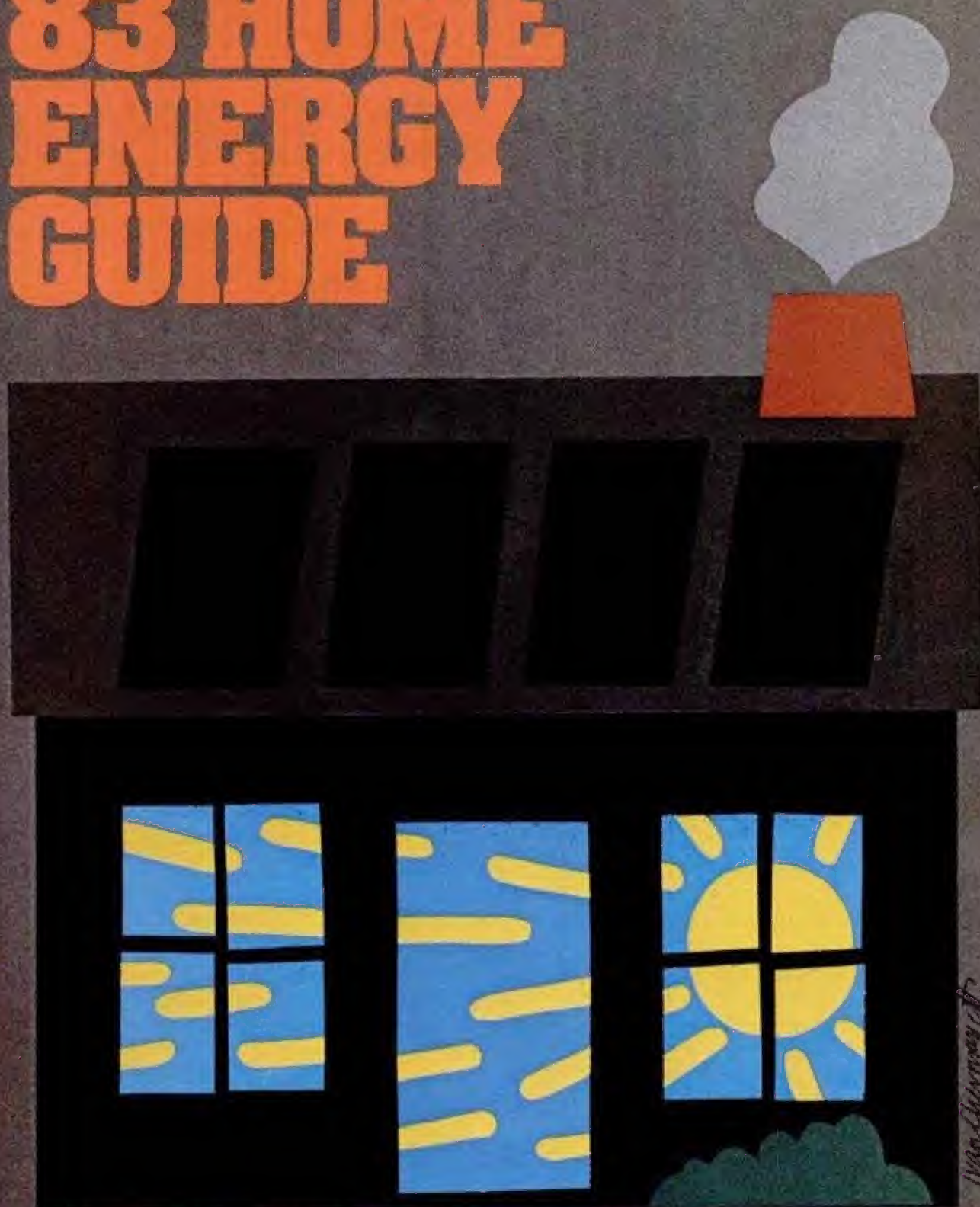


5 A sure way to get a professional-looking surface: First apply quality primer like Plasti-Kote, used here.

using appropriate-grit sandpaper, then dust and tack off the surfaces.

Here are some professional tips that
(Please turn to page 164)

'83 HOME ENERGY GUIDE



Wm. Channing

A passive solar room you can install.

Collecting heat from the sun—a one-day project.

High-tech home heating: Advances in furnaces, boilers and multifuels.

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Arkla Industries, Inc., P.O. Box 534,
Evansville, IN 47704-0534.



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Gas: The future belongs to the efficient.



Solar Rooms That Live

Active homeowners are going passive—with stylish solar room additions in kit form.

BY MICHAEL CHOTINER ASSISTANT HOME AND SHOP EDITOR

Adding a passive solar room to your home is—at least in terms of energy savings—about as close as you can come to getting something for nothing. Properly designed, insulated and oriented toward the sun for maximum gain, a passive solar space will collect more than enough heat for itself and impart the excess to other areas of the home. Such rooms can be used either as attractive, airy living space or as greenhouses.

Several manufacturers offer prefabricated

solar rooms in kit form, often advertising them under the generic name *sunspace* or *greenhouse*. Structural systems range from free-standing glass or plastic enclosures supported by metal extrusions to lean-to style room additions supported by wooden framing. Styles vary widely. Some are angular, while others utilize graceful curving transitions from the roofline to walls. The percentage of transparent wall and roof space will vary with the design.

Most manufacturers offer optional summer

Step-By-Step For A Passive Solar Room



A ledger is attached to existing structure where the beams will join. Rabbeted end strengthens joint between the sections.



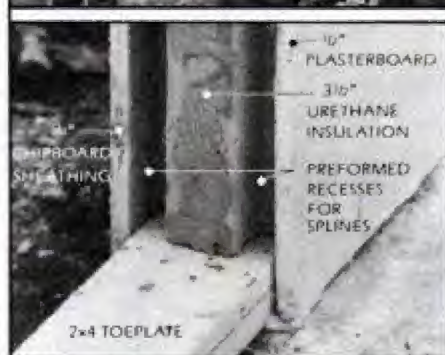
Prebored beam tops are fastened to the ledger with lag screws. The recess in the slab here will accommodate a hot tub.



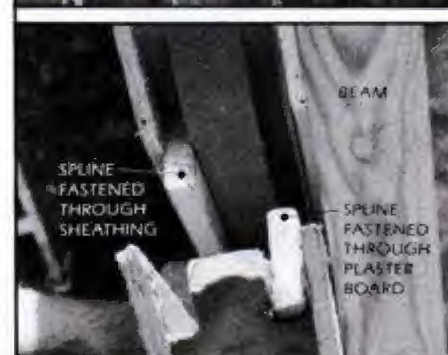
Beam feet rest in metal shoes anchored to slab with lag screws in lead anchors. Cross braces are fastened with screws.



End-wall framing is completed by adding toeplate (not shown) and a vertical stud. Kit is being attached to the roof overhang, which provides extra room depth.



First end-wall panel is lifted into place (top). Bottom photo shows makeup of panel and how it fits over toeplate. Top is nailed to beam with 20d ringed nails.



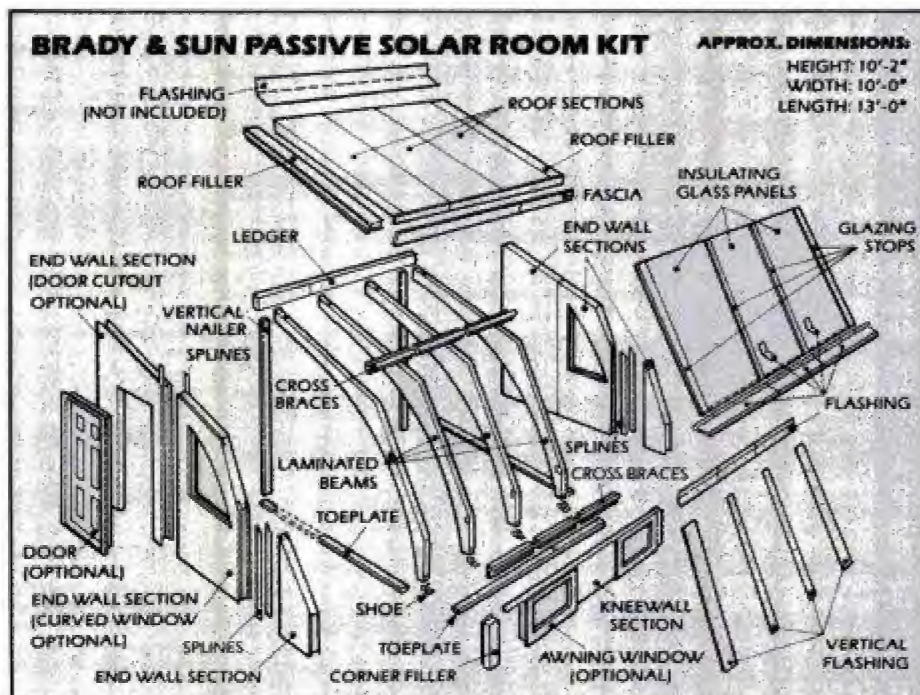
Above, a spline is being screwed into second end-wall panel in preparation for joining it to panel already in place. Bottom photo shows how panels interlock.



Wooden block is used to prevent damage to kneewall panel as it's forced into place. Corner component is visible at left.

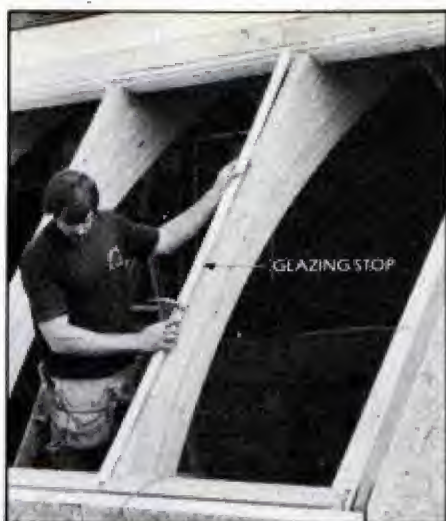


Roof panel is being set in place. Note that plasterboard on inside of end wall will need finishing only at the seam.





End filler component joins roof to end-wall. Topside, it is nailed to beam. It joins sidewalls with splines and nails.



Glazing stops are centered on beams. At top and bottom of window openings, stops are preinstalled on cross braces.



Glazing tape is laid around window openings. When paper is stripped and glass set in place, sun's heat promotes tight seal.



The 46 x 76-in. double-thick insulating glass panels are laid into the frames that are formed by the glazing stops.



Finished sheet-metal flashing is precut and prebored for fasteners. Caulk flashing edges with clear silicone.



Roofing, siding and felt are provided by owner. Brady & Sun LivingRoom completed and decorated is on page 91.

screens that block sun rays during the warm months to keep the sunspace from overheating. Night shutters prevent heat loss during cold winter nights. Many makers also offer thermostatic vent fans to direct heat from the passive solar room to other living areas.

Planning for a sunspace

Although they are often lumped together in a single category, it's important to make a distinction between sunspaces and greenhouses. Their thermal properties are quite different and so are their uses.

Sunspaces generally have at least one glass wall oriented to the south for direct solar gain, with nonglass parts of the structure insulated heavily to trap heat and sustain the room temperature

through a 24-hour cycle of sunlight and darkness.

Greenhouses, on the other hand, usually have a higher percentage of glass surface area than sunspaces, but little capacity for storing heat. The result is that greenhouses are subject to temperature extremes: They tend to overheat in the daytime and cool rapidly at night. Sunspaces are more suitable for living spaces, while greenhouses are most favorable for plants.

Passive solar room kits can be adapted to existing buildings in a number of ways. A slab-on-grade installation is most energy efficient because the slab provides a thermal mass for storing heat. Post and deck construction is suitable for elevating a sunroom kit to an upper story of a home.

For maximum solar gain, windows in a lean-to style sunspace should face true south. Variations of up to 30° from the south, most kit makers claim, do not

impair heat gain significantly. If a southern orientation is impossible, windows in the most southerly end wall are recommended.

In planning passive solar installations, it's also important to consider local weather patterns and the path and position of the sun during the various seasons. For optimal temperature control, operable windows at opposite sides of the structure should be positioned to catch summer breezes. This prevents overheating. Throughout the United States, where the path of the sun is closer to the horizon in winter than it is in summer, be sure that trees and other obstructions won't block sunrays during the heating season.

Purchasing a sun room kit

You can obtain consumer information about the passive solar room kits available either from the companies that manufacture them or from dealer-

PM photos: Peter Tenzer
Installation contractor: Sunspace Design, Arlington, Mass.
Furniture: Wicker Specialties, Arlington, Mass.
Plants: Shrewsbury Nurseries, Shrewsbury, Mass.

REMODELING?



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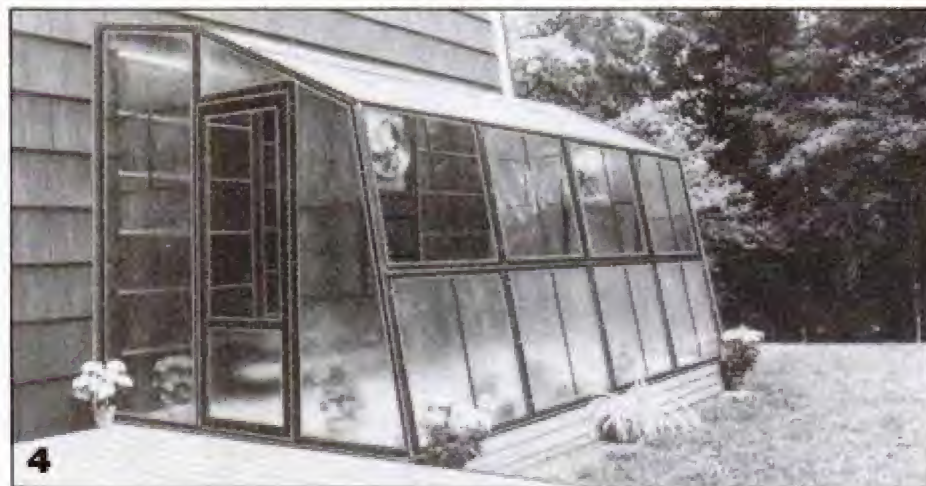
Zip _____ Phone () _____

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© 1983 Andersen Corp., Bayport, MN


Many different passive solar room and greenhouse kits are available for assembly by do-it-yourselfers and contractors. Here's a sampling of styles from several manufacturers: 1. Garden Way's Sun-Room/Solar Greenhouse; 2. Pella's Sun-room; 3. Lord & Burnham's Imperial; 4. Vegetable Factory's Model 5512.



Many factors can affect the energy savings provided by a passive solar addition including the design of the kit itself, the insulation of the existing home, the way the addition of exchanges heat with adjoining space, and number of sunny days during the heating season. It is reasonable to expect that a 10 x 12-ft. passive solar addition will cut fuel costs by about 20 percent in the average home if the installation follows the basic rules. Expect to spend between \$10,000 and \$30,000 if you plan to have a prefabricated sunspace addition installed by a contractor.

One of the advantages of opting for a solar room kit instead of designing and building one from scratch is that many of them can be installed by do-it-yourselfers with reasonable skills and basic tools. The passive solar room shown in our color photo and how-to steps is a Brady & Sun LivingRoom with slight modifications. It is a modular building system consisting essentially of laminated yellow pine beams, prefabricated all-in-one wall and roof panels made up of sheathing, insulation and plasterboard, insulating glass windows, flashings and everything else you need, down to the nails and screws. Many customizing options are available.

Assembly instructions for the Brady & Sun kit are clear and complete. The contractor we worked with in preparing our story told me that in installing 30 or so kits during the past year, he's had problems only when he deviated from the recommended methods.

Weather Shield Mfg. Inc., Box 309, Medford, Wis. 54451.



The deal is legendary, too.

For your local dealer's name call toll-free 1-800-528-6050. Ext. 1430. In Arizona call 1-800-352-7458. Ext. 1430. In Canada, Stihl Ltd., P.O. Box 2364, London, Ontario N6A 4G3.

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Manuscript accepted for publication 16 February 2007



Three collectors on the roof now heat author's studio. Cool air duct is in foreground.

83 HOME ENERGY GUIDE

New Low-Cost Solar Heater You Can Install

BY HARRY WICKS HOME AND SHOP EDITOR

Like most homeowners, I'm constantly on the lookout for ways to lower my home heating costs. While there are a number of fine collector systems on the market, unfortunately many of the most efficient ones are prohibitively expensive. Now, however, there's the Hansolar TA-3.

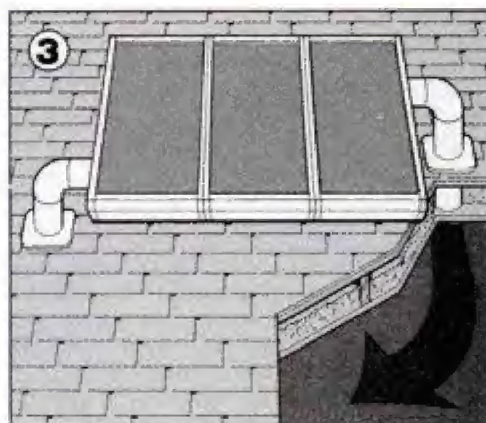
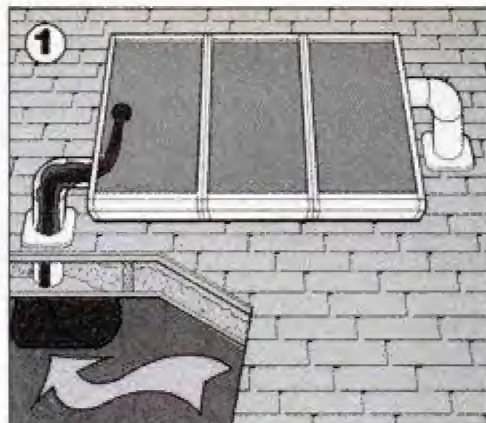
A number of features attracted me to this system. Admittedly, the first was the panels' out-of-the-ordinary good looks, the image of contemporary efficiency. Having installed three panels, I know they perform even better than they look.

It's obvious that considerable attention was given to design detail by the system's inventor, Jack Hanson. An experienced aircraft and missile designer who worked on the U.S. version of the SST until that large aircraft fell from public favor, Hanson says, "I more or

less just stumbled onto this concept." Faced with extraordinary heating expenses in his 200-year-old factory building in Maine, he decided to "re-roof" his building with a collector rather than putting on new roofing material. He opted to bring in some heat while keeping rainwater out. He originally calculated there would be a 25-percent saving in his fuel bill but, he adds with a wink, "Over the first winter, when we saved about 65 percent, I knew my system was a good one."

The extraordinary saving was made possible in large part by the lower cost for materials in the Hanson absorber plates. Surprisingly, each Hansolar TA-3 sells for just \$495.

Hanson sells a two-panel set which enables a homeowner to make an installation with a minimal investment. The absorber plates in a two-collector set take air from your house and raise it about 30° F. In other words, if the air



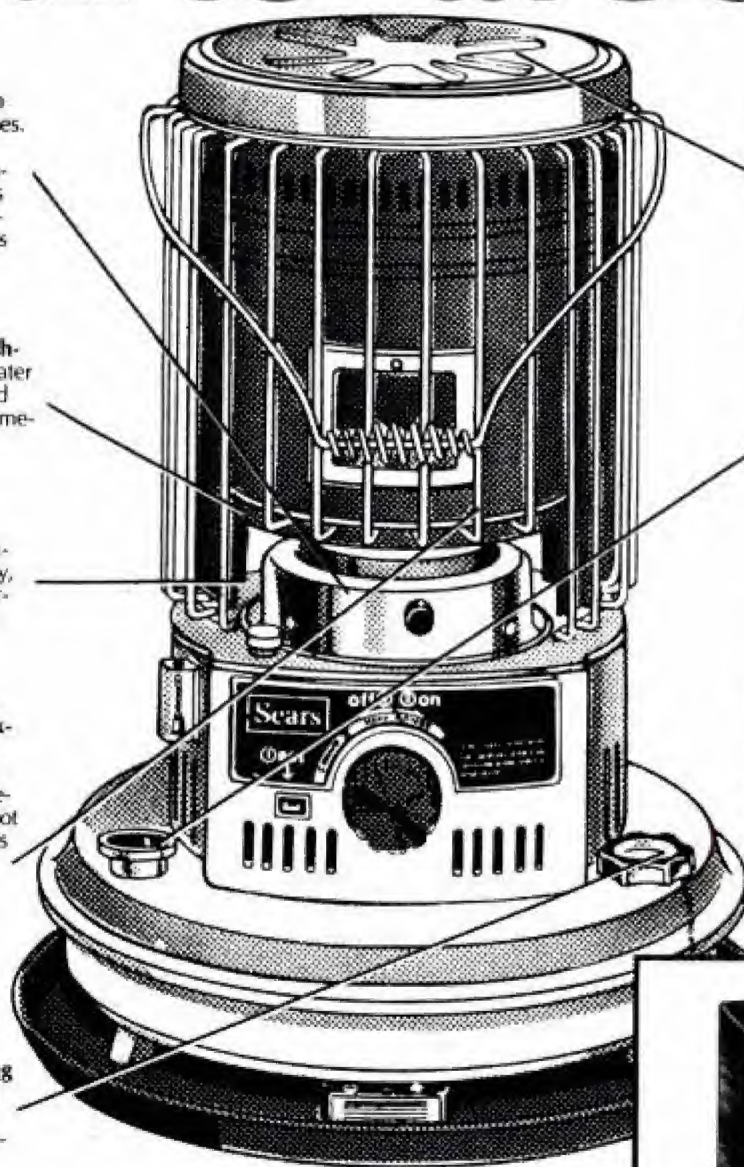
HOW THE TA-3 WORKS

- 1** When temperature on the thermostat reaches 80° F., switch automatically turns on a low-wattage blower which draws cool air in.
- 2** The blower takes air from inside your house and circulates it across the absorber plate, where it is warmed.
- 3** Heated air is immediately pumped back into home through a flexible duct.
- 4** When sun no longer maintains 70° F., thermostatic switch turns blower off.

PM photos: Rosario Capotosto
Installation consultant: Ray Cole

Save \$50 or \$70 and still get these 7 key features—at Sears.

1. **Electric Ignition.** No messing with matches. A small current created by two flash-light batteries ignites the wick. Helps prevent annoying fumes when starting.
2. **Automatic Extinguishing System.** If the heater is accidentally tipped over, the flame is immediately snuffed out.
3. **UL Listed.** Meets Underwriters Laboratories accepted safety, construction and performance standards.
4. **Replaceable Porous Ceramic Wick for extended service life.** On reflection model shown below, you replace only the top, not the whole wick. Parts and service are available through Sears.
5. **A Manual Siphon Pump for Easy Fueling is included.** Virtually eliminates the possibility of fuel spill. (Reflection model also has a removable fuel tank.)



6. **Baked Enamel Top.** Ordinary paint can burn off of hot surfaces. Baked enamel resists scorching.

7. **Fuel Level Indicator.** No need for dip stick. You can see at a glance how much fuel you have.

19,700 BTU Convection Heater. Big capacity for large areas.

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\$149⁹⁹
SAVE \$50



9,300 BTU Reflection Heater. All the listed features of the larger unit, plus built-in electric fan for better heat distribution.

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SAVE \$70

Before you buy any kerosene space heater, shop Sears—space heating headquarters—where you'll find a great selection of quality-engineered kerosene heaters. Check and compare with other heaters the features we offer in both of these Sears units. On sale August 28th to September 17—so shop now.

Minimum savings nationally. Prices and dates apply only to the continental United States except Alaska. Available at most Sears Retail Stores.

Check state and local codes for permitted uses; Calif., Mass., and Wisc. have restrictions on use in dwellings.



Sears

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'83 HOME ENERGY GUIDE



First step on the roof: Use a tape measure to lay out for the most pleasing plate appearance and efficient duct run.



Panels snap together in minutes. Most assembly is done at factory. Here, designer Jack Hanson installs the second bracket.



Panels are lightweight and easily transported up ladder by one man, then handed to work partner already on the roof.



Parts for clamping the brackets come with kit. After boring pilot holes in roof sheathing, lagscrews are installed.



To join two or more units, the knockouts along mating sides are removed and units are coupled using short pipe lengths.



An elbow is fitted to a length of duct and exact location for duct cutout is marked.



Using an extra-long drill bit, a hole is bored through at exact center of cutout.



Duct hole is cut out with sabre saw. Then, the duct is positioned to mark the floor.



Permanent installation of the roof duct is through a roof flange. Latter is installed with upper edge under shingles. All edges are then sealed with caulk.

going into the panels is about 60° F., you will get warm air out the other end at about 90° F. These figures depend on time of year and angle of the sun.

Unlike most solar collector plates, which warm the air by passing it between glass face and absorber plate, the TA-3 is constructed of a pair of plenums which heat the air by passing it *behind* the absorber plate. Jack's reasoning was that by passing air behind the absorber plate, less heat would be lost to the atmosphere.

Made of injection-molded expanded polystyrene, the panels are lightweight and easy to handle, each weighing just 30 pounds. It's very easy for one man to haul a panel to the roof.

Hanson Energy Products also manu-

factures a collector system for heating domestic hot water. Dubbed the Hansolar (H₂O) System, the design varies from most because it employs just one pipe to transport cool water to the collector panels and return hot water from them.

Start by trying to place your plates so that they face true south (not the magnetic south pointed out by your compass). Check a U.S. Geological Survey map to determine true south, which can vary by as much as 30° either east or west of magnetic south. It's also important that the rays of the sun strike perpendicular to the absorber panel. For that reason, Hanson has three different bracket styles which will place the panels at approximately a 45° tilt.

(Please turn to page 100)

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Everything about Homer Formby's new Wood Stains and Finishes is designed to make it easier for you to create a beautiful finish — the kind of professional-looking results you'll be proud of.

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Tankless Heater Provides Endless Hot Water



The Hughson family of Pennsylvania

The Hughson family just took 7 showers in a row — the 7th was as hot as the first — and they're saving hundreds on their hot water bills too.

Sound, Simple, Money-Saving Idea

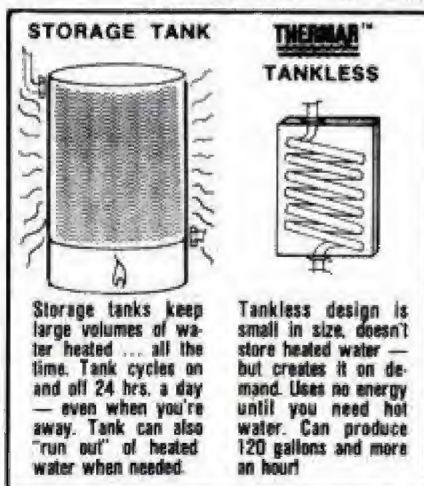
Did you know that much of the energy used to heat your basement tank of water is dissipated right through the walls of the tank itself and into your storage or crawl space area?

The Perfect Answer—New Thermar™ Tankless Instant Hot Water Heaters

If heat losses are created by the need to keep large volumes of water standing in a tank, why not eliminate the tank? And, that's just what Thermar™ has done. In its place we have developed a tiny, super powerful instantaneous heating unit which ACTUALLY CREATES HOT WATER AS YOU USE IT. A microswitch on the unit automatically turns on the moment hot water is needed. Then a continuous stream of delightful, sparkling hot water flows from the tap for shower or wash basin. IMAGINE — as much hot water as you want — produced in a never-ending stream as long as you need it.

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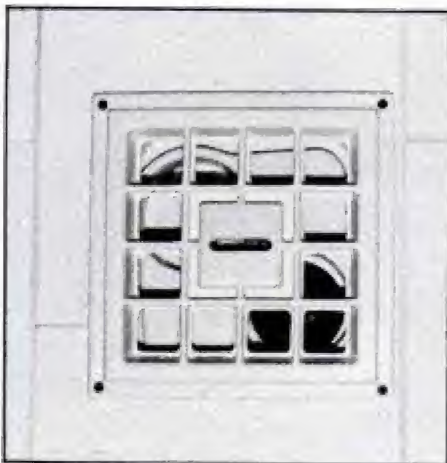
(Continued from page 98)

You can obtain a solar planning kit which includes more information about the Hanson products, as well as complete installation instructions and an owner's manual for \$2 from Hanson Energy Products, River Rd., Newcastle, Me. 04553.

PM



Inside, the blower that feeds the cold-air duct is installed. Complete wiring instructions are packaged with the kit.



Hot-air register is on ceiling at other end of room from blower. Note thermometer.



After the blower has been completely wired, the protective cardboard covering the plate face is removed. The cardboard stays on during the entire installation.

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Good for \$25,000 a year and more...much more!

When George Singleton made \$4,154.65 on one order for Seamless Spray, he said it seemed like a miracle...making such Big Money with so little effort. But that's the remarkable track record of our SEAMLESS SPRAY...the process that makes old roofs like new again.

One new man after another has enjoyed the same BIG SELL thrill when they introduced Seamless Spray and closed sizable orders on the first call.

Like Joe Kimpel, a former welder, who was making \$1,000 a month. His first 5 weeks with Pace paid him \$2,799.69.

Bob Kronner, 55-year old former steel salesman, made one call, got his first Seamless Spray order, and made \$1,429.43.

How can this happen so easily for men with no experience in our business? It's all very logical.

If you've talked to a roofer lately, you know the incredible charges for putting on new roofs. For industrial buildings, shopping centers, motels, hospitals, schools, etc., prices have gone sky-high. With our process, we bypass the roof contractor. The commercial building owner uses our Seamless Spray to apply Pace Roof Renewal Sealant right over the old roof. The cost is so low, the proven results so satisfactory for such well-known firms like General Motors, American Airlines, Holiday Inns and hundreds more, there is virtually no sales resistance.

Pace ships Seamless Spray equipment on Free Loan. Your customer pays only for the Sealant. His own men apply it. It's as simple as that.

The field-tested sales kit we furnish you gives you all the know-how you need to get into this BIG SELL immediately. There's no waiting, no training needed. You don't waste your time on small, penny-ante business.

YOU CONCENTRATE ON BIG SALES—BIG EARNINGS

That's how part-timer Jim Deveau earned a weekly check for \$2,760. (We think he'll go full-time now!) How Dave Lute, with 2 sales in 2 days, made over \$1,500. And how rookie Bob Shelhorn parlayed several roofs for one company into a \$1,433.78 paycheck!

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PACE PRODUCTS, Dept. PM-983
81st and Indiana, Kansas City, MO 64132

PLEASE RUSH BY MAIL all facts about Pace SEAMLESS SPRAY, the amazing part-time money maker that's good for \$25,000 a year...and more. No obligation. ☐ ICE MELTER

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Address

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Cut Your Fuel Bills- Up To 40%

The newest furnaces and boilers are nearly twice as efficient as units available five years ago. Here's how they work.

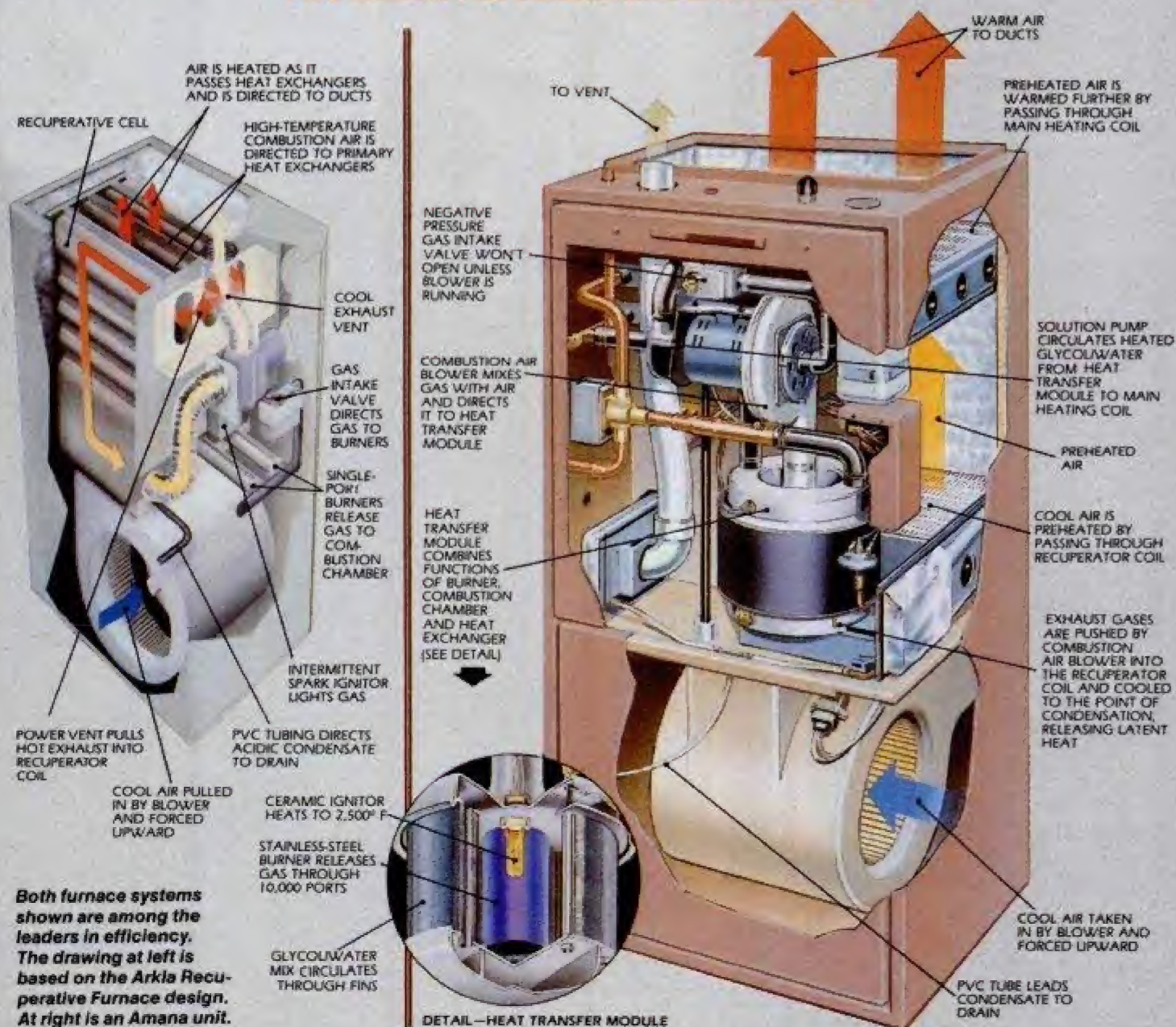
BY MICHAEL CHOTINER AND JOHN H. INGERSOLL

Highly efficient designs for furnaces and boilers, inspired by the fuel shortages of the 1970s, are now available to homeowners after years of research and development. According to test results published by the U.S. Department of Energy and the claims of the equipment makers, the new breed of

heating units is from 26 to 40 percent more efficient than the various types of equipment on the market only five years ago.

Efficiency ratings are based on the amount of heat that a furnace or boiler can extract from a unit of fuel compared to the heat potential within the

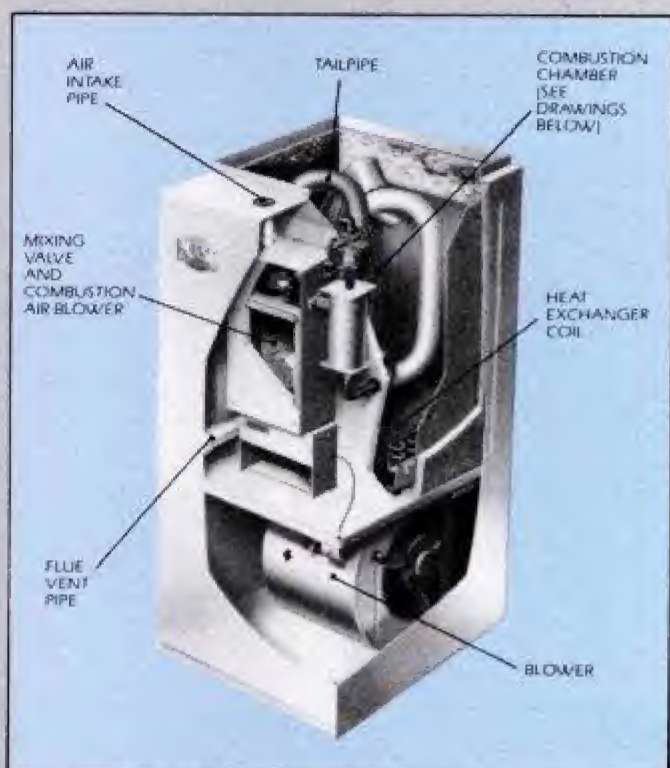
TWO DESIGNS FOR CONDENSING GAS FURNACES



Both furnace systems shown are among the leaders in efficiency. The drawing at left is based on the Arkla Recuperative Furnace design. At right is an Amana unit.

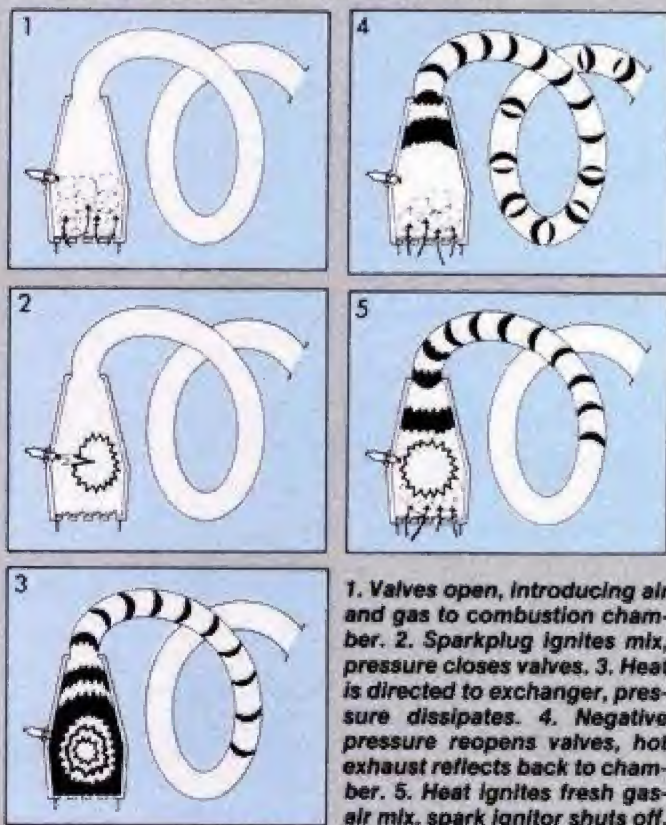
fuel. In standard calculations, performance is averaged over the period of one year to compute a percentage rating known as the annual fuel utilization efficiency (AFUE).

To cope with the inadequacies of old-style heating equipment which, at best, posts AFUE ratings of 50 to 55 percent, engineers have found ways to eliminate pilot lights and have found methods to burn fuel more



The Lennox Pulse Furnace (above) has an extremely efficient and thorough system for burning fuel. See details below.

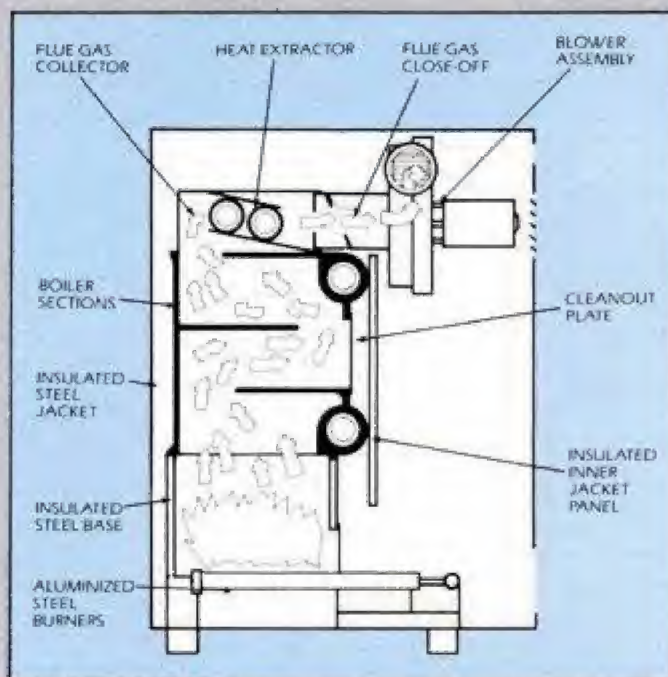
PULSE COMBUSTION SYSTEM



completely. Components have been developed to capture heat that formerly went up the flue with exhaust gases. Special attention has been given to redesigning heat exchangers, elements within furnaces or boilers that transfer the heat of combustion to the ducts or pipes.

Along with solving the problems of old-style heating units, engineers have had to develop designs to cope with problems arising from the new technology. Ways to dispose of acidic solution condensing from the cooler exhaust gases have been found. New rules have been developed for specifying the required output of high-efficiency units that replace old-style furnaces and boilers. The prevailing mentality had been to install oversized units capable of providing more than enough heat on the coldest day of the year—by definition, an inefficient approach.

The economics of heating efficiency are simple: A homeowner can cut his fuel costs by 1 percent for each percentage point gain in efficiency. If you own an old-style heating unit and replace it with one 40 percent more efficient, you will probably save enough on fuel to pay yourself back in three to five years. What is



Drawing of Well-McLain VHE gas boiler shows induced draft system and heat extractor, a secondary heat exchanger.

fascinating is the number of different approaches to creating efficient heating systems that can be seen in furnaces and boilers now on the market.

Efficient heat, transfer system

The Amana Energy Command furnace, designed for forced warm-air systems, has a U.S. Department of Energy rating of 94 to 95 percent AFUE. (Like EPA mileage ratings for cars, sources tell us, DOE efficiency ratings should be taken with a grain of salt.) Among its many advanced components, Energy Command's Heat Transfer Module (HTM), which combines the functions of a gas burner, combustion chamber and heat exchanger, is an engineering standout.

An electricity-powered ceramic igniter inside the HTM begins to heat up at a signal from the thermo-

HIGH-EFFICIENCY HEATING UNITS: CONSUMER INFORMATION

GAS WARM-AIR SYSTEMS

Maker	Brand Name	Input (B.T.U./Hr.)	AFUE*	Installed Mode	Natural Gas (N) or Propane (P)	Approx. Cost (Installed)
Airtemp	Airtemp	(Same specs as Fedders)				
Amana	Energy Command	80,000 to 100,000	94% to 95%	Upflow	N or P	\$2,000-\$3,500
Arkla	Arkla Recuperative	40,000 to 120,000	86% to 87%	Upflow or Downflow	N or P	\$1,300-\$1,500
Bryant	Formula 1000	48,000 to 143,000	83%	Upflow	N or P	\$1,100-\$1,300
	Formula 2000	48,000 to 143,000	82%	Downflow or Horizontal	N or P	\$1,100-\$1,300
Carrier	Super Saver	48,000 to 167,000	82%	Upflow	N or P	\$1,100-\$1,300
	Super Furnace	48,000 to 143,000	82%	Downflow or Horizontal	N or P	\$1,100-\$1,300
Climatrol	Climatrol	(Same specs as Fedders)				
Day & Night	(Same brand names and specs as Bryant)					
Fedders**	Fedders	80,000 to 110,000	81% to 82%	Upflow	N or P	\$1,500-\$1,800
Heil-Quaker	Energy Marshall II	50,000 to 105,000	92% to 96%	Upflow	N	\$1,500-\$2,000
Lennox	Pulse	40,000 to 130,000	91% to 96%	Upflow	N or P	\$2,000-\$3,300
Magic Chef	Ultra	60,000 to 87,500	86% to 87%	Upflow	N	\$1,500-\$1,700
Payne	Answer One	48,000 to 143,000	83%	Upflow	N or P	\$1,100-\$1,300
	Answer Two	48,000 to 143,000	82%	Downflow or Horizontal	N or P	\$1,100-\$1,300
Sears	Kenmore	(Same specs as Heil-Quaker)				
Whirlpool	Tightfist II	(Same specs as Heil-Quaker)				

OIL-FIRED BOILERS

Maker	Brand Name	Input (B.T.U./Hr.)	AFUE*	Approx. Cost (Installed)
Blueray Systems	Blueray II	91,000 to 150,000	85% to 87%	\$2,000-\$2,500
Burnham	Burnham	84,000 to 147,000	83% to 84%	\$2,000-\$2,500
Circle Combustion	Circle Combustion	87,000 to 182,000	Over 85%	\$2,200+
Energy Kinetics	System 2000	102,000 to 120,000	83%	\$2,500-\$3,000

GAS-FIRED BOILERS

Maker	Brand Name	Input (B.T.U./Hr.)	AFUE*	Natural Gas (N) or Propane (P)	Approx. Cost (Installed)
Burnham	AG2000	96,000 to 164,000	83% to 84%	N	\$2,300-\$2,600
Hydrotherm	Hydro-Pulse	50,000 to 150,000	90% to 91%	N or P	\$2,800-\$3,400
Well-McLain	VHE	67,000 to 167,000	87%	N	\$2,000-\$3,200

*AFUE stands for Annual Fuel Utilization Efficiency, also called Seasonal Efficiency (see text for explanation).
+ Price includes domestic hot-water heater.

**The Furnace Div. of Fedders Corp. (including Airtemp and Climatrol brands) was put up for sale in April 1983. You'll still recognize the brands, since it's unlikely the buyer will change them.

stat. It takes about 30 seconds to reach its peak temperature of 2,500° F. A blower mixes air and gas and directs it into the HTM, where it is released through some 10,000 tiny ports in the burner. Combustion is touched off by the hot igniter.

A network of steel fins surrounding the burner absorbs the tremendous heat of combustion. It's passed on to a 50/50 glycol-water solution coursing

through tubing within the fins. From there, the liquid is pumped to the main heating coil. Exhaust gases leave the HTM at about 300° F. and are directed to a recuperative coil which cools them further. Condensation occurs there, releasing latent thermal energy. Exhaust is cool enough to be vented through a sidewall and condensate is led via plastic tubing to a suitable drain.

House air to be heated is drawn in by

a blower at the furnace base and directed first through the recuperator coil, where it is preheated, then up through the main coil for final heating and on into the ducts.

A dry recuperative furnace

The Arkla Recuperative Furnace achieves efficiencies comparable to the Amana unit using a different, simpler system. Activated by a thermostat, sin-

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5 mg



5 mg



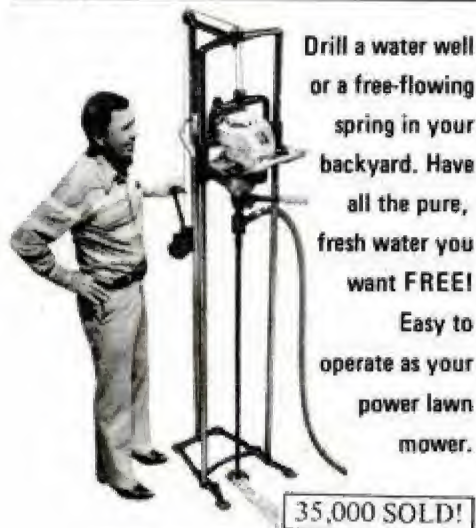
2 mg

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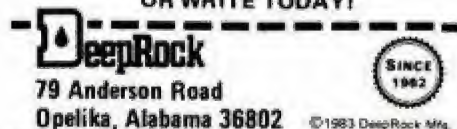
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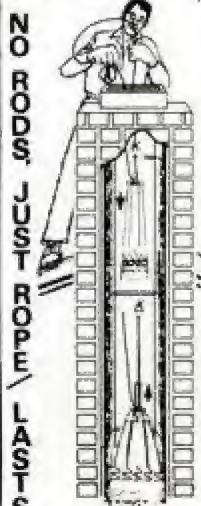


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regardless of size of
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OGEMA, WI 54459.

83 HOME ENERGY GUIDE

gle-port gas burners inject gas into the combustion chamber, where it is lit by an electronic spark igniter. The manufacturer claims that the single-port burner system is most reliable because of its resistance to clogging.

After ignition, the very hot combustion air is directed into ribbed aluminized heat exchangers. The ribbed design of Arkla's heat exchangers provides extra surface area for maximum heat transfer. Combustion air leaves the heat exchangers at 400° to 500° F. A fan pulls the partially cooled air into a recuperative cell, similar to the primary heat exchanger unit, but made from stainless steel to prevent damage from corrosive condensate.

The heat exchangers and recuperative cell impart the heat of the combustion air inside to air circulated past them by a blower at the furnace base. The cooling effect of the air blowing past the recuperative cell causes condensation to occur and, consequently, releases latent heat.

Pulse combustion

The Lennox Pulse Furnace is designed to sustain a combustion process touched off by a single spark throughout an entire ON cycle. Air and gas are directed into and mixed in the combustion chamber, then touched off by a sparkplug-like igniter. The pressure buildup inside the chamber caused by the explosive force of initial combustion causes the gas and air inlets to close. The hot gas produced by combustion moves from the combustion chamber into a long, convoluted heat exchanger. As the combustion chamber empties, the pressure inside drops to a negative level, drawing air and gas for the next combustion pulse. Some of the hot gas is reflected back into the combustion chamber from the end of the tailpipe, and it's the heat from the reflected gas that lights the newly introduced gas/air mixture. The process occurs at a rate of 60 to 70 times per second, eliminating energy consumption for an igniter and burning fuel with heretofore unknown thoroughness.

Exhaust gases escaping the heat exchanger are routed to a condensing coil fitted with a drainage tube. Air circulated by a blower picks up heat from the condensing coil and from the surfaces of the heat exchanger. Then, it is directed through the ductwork.

Condensing gas boiler

Weil-McLain's VHE (very high efficiency) gas boilers adapt the technology for condensing heat exchangers to forced hot-water heating systems. The innovation enables the VHE systems to

perform about 20 percent more efficiently than conventional boilers.

At the start of the ON cycle, a pump begins to circulate water through the boiler. An electric spark ignites a pilot, and then the main gas valves open to ignite the burner. Induced draft from a blower pulls combustion gases past the water-filled boiler sections rapidly, speeding the heat exchange rate. The exhaust gases are then sent to a secondary heat exchanger. Relatively cool water returning from heating pipes is preheated by the secondary heat exchanger before being recycled through the boiler. Finally, cooled exhaust is directed out through a vent which has a damper that closes during OFF cycles to retain heat in the boiler.

Heat-purging boilers

Another development in the area of hot-water heating systems is the "heat-



Circle Combustion's compact boiler and water heater use heat-purging systems.

purging" boiler. While most old-style boilers circulate hot water to radiators from a holding tank containing 16 to 23 gal., maintained constantly at high temperature, heat-purging boilers use only

MANUFACTURERS LIST

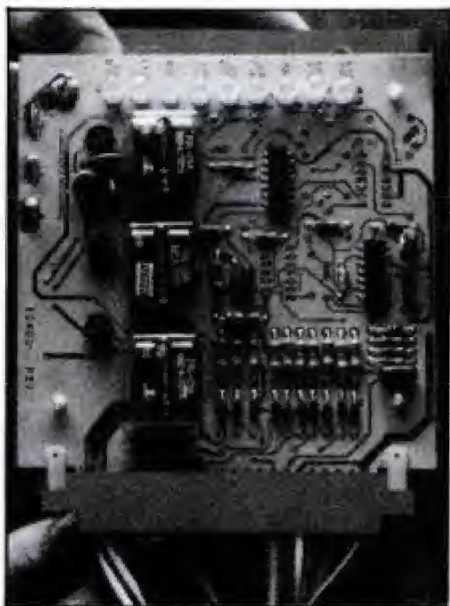
Airtemp (see Fedders Corp.).
Amana Refrigeration Inc., Main St., Amana, Iowa 52203.
Arkla Industries, Box 534, Evansville, Ind. 44704.
BDP Co., Box 70, Indianapolis, Ind. 46206.
Blueray Systems Inc., Rt. 61 S, Schuylkill Haven, Pa. 17972.
Bryant (see BDP Co.).
Burnham Corp., Box 3079, Lancaster, Pa. 17604.
Carrier Air Conditioning, Carrier Pkwy., Syracuse, N.Y. 13221.
Circle Combustion, Southside Ave., Hastings-on-Hudson, N.Y. 10706.
Climatrol (see Fedders Corp.).
Day & Night (see BDP Co.).
Energy Kinetics, Box 407, Bernardsville, N.J. 07924.
Fedders Corp., Woodbridge Ave., Edison, N.J. 08818.
Hell-Quaker, Box 40566, Nashville, Tenn. 37204.
Hydrotherm, Rockland Ave., Northvale, N.J. 07647.
Lennox Industries, Box 400450, Dallas, Tex. 75240.
Magic Chef, 851 West 3rd Ave., Columbus, Ohio 43212.
Payne (see BDP Co.).
Sears Tower, Chicago, Ill. 60684.
Weil-McLain, Blaine St., Michigan City, Ind. 46360.
Whirlpool (see Hell-Quaker).

'83 HOME ENERGY GUIDE

2 to 5 gal. of water. When the thermostat is satisfied and a heating cycle ends, the burner shuts off and all remaining hot water is circulated through the system by a pump. Heat-purging boilers consume fuel only when they are on, saving fuel that formerly had been used to maintain water temperature constantly.

Units offered by Energy Kinetics and Circle Combustion, though different from one another in design specifics, operate with heat-purging systems. Both incorporate retention-head burners under high pressure to achieve temperatures of nearly 3,000° F. Energy Kinetics units and those made by Circle Combustion are designed to supply hot water needs at the rate of 168 gal./hr. and 120 gal./hr., respectively.

There are many other brands that have incorporated the new technologies. See the chart on page 104 for a more complete listing. **PM**



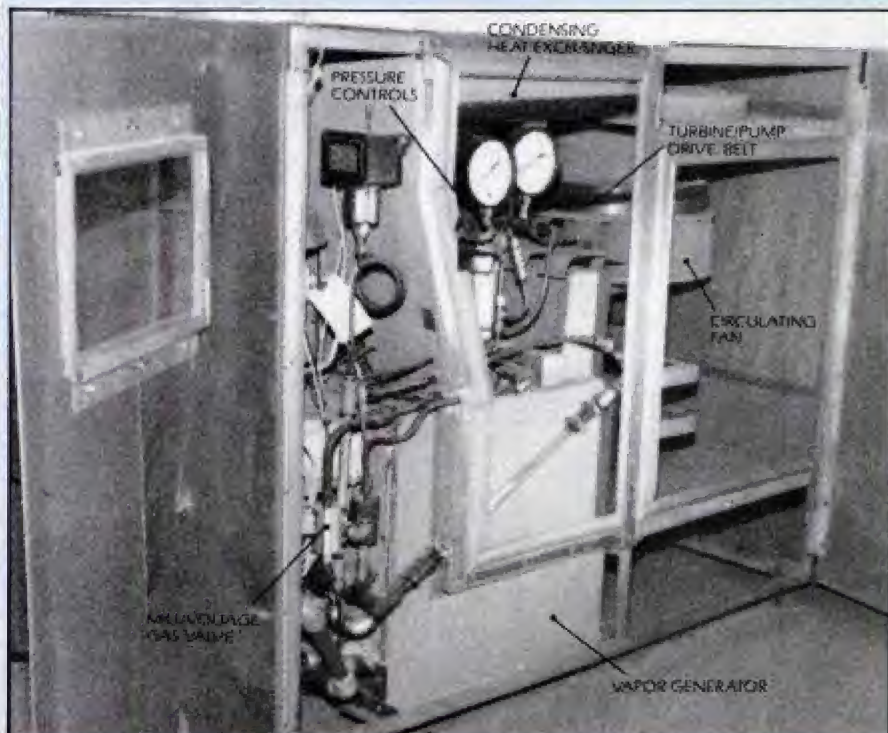
The XG2000 gas boiler manufactured by Burnham is equipped with a logic module to troubleshoot its own malfunctions.

A Gas Furnace That Runs On Its Own Steam

Field tests are planned this winter for a new gas furnace that does not require electricity. The furnace, developed by TRD Corp., uses a liquid medium that's boiled and circulated through a condensing heat-exchanger unit. Steam produced in the process drives a Rankine turbine which produces mechanical power to operate the blower. The pilot light runs a 750-millivolt thermopile to provide power for the thermostat.

Aside from its high fuel efficiency

(around 84 percent), the TRD Self-Powered Furnace is designed to save homeowners money in several other ways. TRD has a standing pilot instead of an electronic ignition. Electronic ignitions frequently require service calls. TRD also says that electric operating costs for most other high-efficiency gas furnaces run about 16 percent of the fuel cost, a factor ignored in many sales presentations. Contact TRD Corp., 5181 West 161st St., Cleveland, Ohio 44142.—M.C. and J.H.I.



TRD's Self-Powered Furnace, pioneered with funds from New York state utilities, requires no electricity to operate. It may be available sometime next fall.

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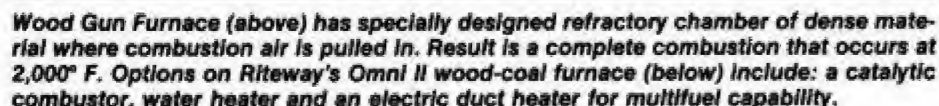
State _____ Zip _____

After more than a decade of fluctuations in the price and availability of heating fuel and with future prices uncertain, the multifuel heating unit seems to be a product whose time has come. Multifuel units are designed to operate using a choice of two or more fuels—one a solid fuel like wood or coal, the other a conventional fuel like gas, oil or electricity. Central heating systems are now available that operate on virtually any combination of fuels. There are multifuel furnaces which supply heat for forced-air systems and multifuel boilers for hot water or steam heat systems.

One of the greatest advantages of multifuel heating units is the degree of flexibility they allow. They enable you to burn the least expensive or most convenient fuel your unit uses. They also offer built-in backup systems. For example, if on the coldest days of the year the woodburning mode can't supply heat at a comfortable level, the thermostat(s) controlling the multifuel unit will, in almost all units, automatically switch on the conventional fuel mode. By the same token, when a wood fire dies out, the conventional mode in some units will automatically take over, so there is little danger of pipes freezing if you are away for extended periods.

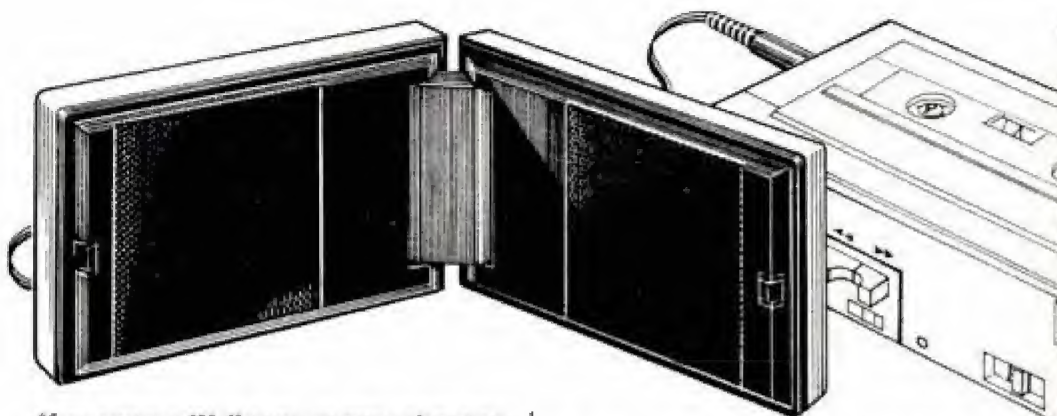
Some manufacturers offer designs that sustain wood fires for as long as 12 hours. In models where there is a single combustion chamber for solid and conventional fuels, the conventional fuel will automatically light the solid fuel and then shut off, so little manual fire tending is required other than loading up with solid fuel. One manufacturer, EFM, has even brought back a technology from the heyday of coal burners: An automatic stoker feeds coal into its multi-fuel units (see photo, page 110).

The multifuel concept is not new. Multifuel heating units have been on the market since the mid-'50s. Interest in these versatile and economical central heating systems has now risen to the point where *Air Conditioning, Heating And Refrigeration News* reports that the industry is selling some 12,000 units



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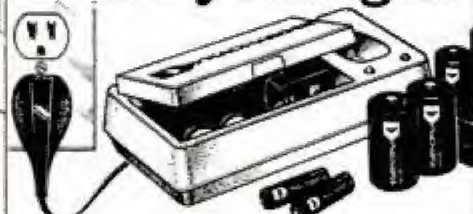


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per year. Installed, a multi-fuel system will cost you between \$2,500 and \$4,000 or more. Multifuel boilers generally will fall at the high end of this range.

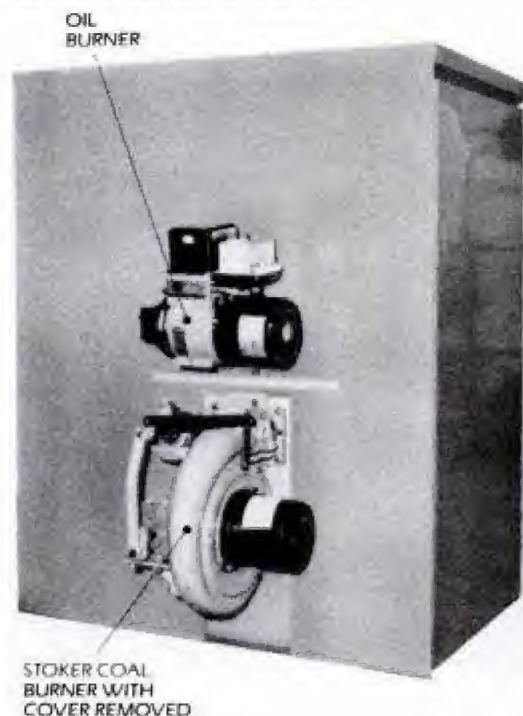
The growing popularity of multifuel heating also has brought with it improvements in technology. For example, in some early units without separate combustion chambers for solid and conventional fuels, the conventional fuel burner often became clogged with soot and creosote, byproducts of solid fuel combustion. Some makers have redesigned units providing separate fireboxes.

Others have designed systems that greatly reduce smoke and creosote, at the same time increasing the amount of heat extracted from solid fuels. Riteway, for example, is selling a catalytic combustor as optional equipment on its multifuel furnace. Similar to the catalytic converters designed to reduce auto emissions, catalytic combustors burn up smoke at relatively low temperatures (about 500° F.). Extra heat is produced by burning the smoke, and the catalytic combustors reduce air pollution and inhibit the formation of creosote. (Current data indicate that catalytic combustors last about two years before burning out. Replacement costs \$50 to \$60, so thought should be given to your needs for efficiency and air pollution control before deciding on a unit equipped with a catalytic combustor.)

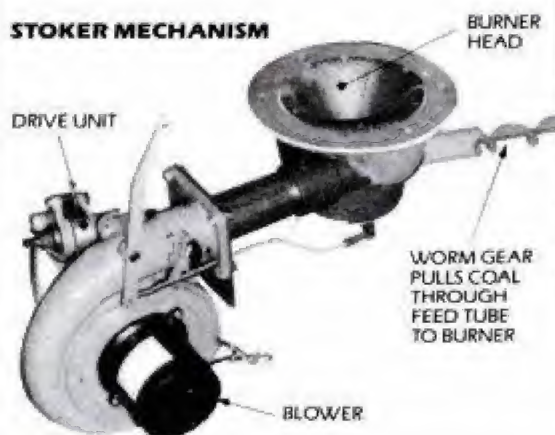
Another method of eliminating smoke and creosote produced by burning wood is called "gasification." In this process, wood is baked in an oxygen-deficient atmosphere to produce a highly flammable gas that is drawn off, mixed with oxygen and then burned at temperatures exceeding 2,000° F. This results in more complete combustion and enables the unit to extract more heating energy from the wood. Essex Thermodynamics and Eshland Enterprises make boilers using this process.

Yukon Energy Corp.'s electric-solid fuel furnace is the first of its kind to be listed by Underwriters Laboratories. The electric mode produces 20 kw with

COAL/OIL BURNING FURNACE



STOKER MECHANISM



Up to 20 pounds of coal per hour is automatically fed to burner by a stoker system in EFM's coal/oil boiler. Oil burner located on top has a flame retention head. Boiler has a hot-water coil, comes as a steam boiler, too.

four 5-kw elements, each on a 45-second time delay. The delays prevent power surges.

In addition, high-efficiency devices developed for conventional heating units have been adapted to multifuel units. Retention head oil burners, flue dampers, improved combustion chamber jacketing and heat-reclaiming devices in various forms have been incorporated into many multifuel units.

Most multifuel units require only a single clay-tile flue or a single UL-approved, all-fuel metal chimney. However, check local codes and insurance regulations. There has been some concern that creosote from solid fuel fires can block flues. While a clogged flue is obvious when solid fuel fires are burn-

ing (the room fills with smoke), unvented gas is more dangerous because it is almost undetectable. To be listed by Underwriters Laboratories, all multifuel units must have a means of detecting a restricted flue. Manufacturers have introduced pressure- and temperature-sensing devices that turn burners off under unsafe conditions.

It pays to spend some time learning about multifuel heating units before you shop. *Solid Fuel Furnaces And Boilers*, written by John W. Bartok Jr. and published by Garden Way Publishing Co., Charlotte, Vt. 05445, is an excellent guide.

You should also evaluate your specific needs and the restrictions of your home before selecting a unit.

First, determine the square footage of your home and the square footage of floor, wall and roof areas. Note the type and thickness of wall insulation and the presence or absence of storm windows and insulating glass. This will help your dealer to recommend units of the appropriate size.

Second, determine the size of the area in which your multifuel heater will be placed and whether sufficient combustion air is available. The room must have adequate fireproofing and enough space to provide safe clearances be-

tween the heating unit and any combustible materials.

Third, it is important to acquaint yourself with the price and availability of fuels in your area and make an informed projection about both.

After you narrow your choices with respect to fuel costs and supplies, compare units based on both *combustion efficiency* (the percentage of energy content in fuel that is converted to heat) and *thermal efficiency* (the percentage of heat that gets into the home compared to that which goes up the flue).

Make certain that the unit you select is listed by a reputable independent testing laboratory. Look for a UL label, or one of the following: Energy Testing Laboratories of Maine (ETLM), Warlock Hersey International, Arnold Green Labs Inc. and PFS Corp.

Select a dealer and an installation contractor who can provide reliable references and service. Check with your local fire department and building department to be sure the multifuel unit and its installation comply with the local codes.

PM

MANUFACTURERS LIST—

MULTIFUEL FURNACES AND BOILERS

w-wood c-coal o-oil g-gas e-electricity

Note: Models are available to burn the fuels indicated, but a single model doesn't necessarily burn all fuels noted.

Furnaces

Charmaster Products Inc., 2307 Hwy. No. 2 West, Grand Rapids, Minn. 55744; Charmaster and Chateau models: w, c, o, g.

Sam Daniels Co. Inc., Box 866, Montpelier, Vt. 05602; w, o. Decton Iron Works Inc., 21385 West Good Hope Rd., Lannon, Wis. 53046; Russell furnace; c, w, o.

Dornback Furnace & Foundry Co., 33220 Lakeland Blvd., Eastlake, Ohio 44094; w, c, o, g.

Fabridyne Inc., Box 1040, Litchfield, Minn. 55355; FWO series; w, c, o.

Longwood Mfg. Co., Gallatin, Mo. 64640; w, o, g.

Oneida Royal Inc., Box 148, Oneida, N.Y. 13421; ACO series, c, o, g; AWGO series, w, o, g.

Rifeway Mfg. Co. Inc., 100 Triangle Dr., Weyers Cave, Va. 24486; LF-20, Dyna I and II, Omni I and II; w, c, g, o, e. Thermo Products Inc., Box 217, North Judson, Ind. 46366;

Thermo Pride w/c furnace can be combined with Thermo Pride or other g/o furnace; supplemental hot water.

Yukon Energy Corp., 9890 Northeast Hwy. 65, Minneapolis, Minn. 55434; w, c, o, g, e.

Boilers

American-Energy Marketing Associates Inc., 4642 Crossroads Park Dr., Liverpool, N.Y. 13088; Chappae Bermuda PN series; hot-water heat; w, c, o, g.

Arrow Heating Equipment Ltd., 1703 East Main, Torrington, Conn. 06790; Neca SC series; hot-water heat, c, o, g.

Burnham Hydronics Div., Lancaster, Pa. 17604; Woodlander, w, c, o.

Dumont Industries Inc., Box 148, Monmouth, Me. 04259; Tempest hot-water heat; w, o, g.

EFM, Div. General Machine Corp., Emmaus, Pa. 18049; stoker boiler; hot-water heat; also as steam unit; o, c.

Essex Thermodynamics Corp., Box 817, Essex, Conn. 06426; hot-water heat; w, o, g.

Eshland Enterprises Inc., Box 23, Greencastle, Pa. 17225; Wood Gun, w, o, g.

New England Boiler Mfg. Inc., 790 Old Colony Rd., Meriden, Conn. 06450; w, c, o, g.

Northland Boiler Company, East Haddam, Conn. 06423; DF series boiler for hot-water and steam heat; w, c, o.

Oneida Royal Inc., Box 148, Oneida, N.Y. 13421; CWOB series, w, c, g, o.

Tekton Corp., Conway, Mass. 01341; HS Tarm OT and 500 series; hot-water heat; w, c, o, g, e.

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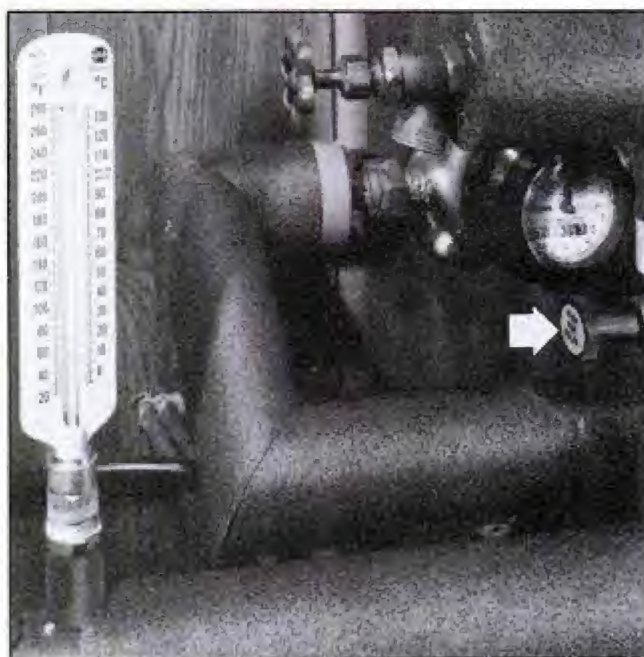
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Solar-Assist Heat Pump Follow-Up Report: A YEAR OF SAVINGS

Here are the findings for PM's hot-water heat pump installation assisted by two solar systems, as promised in the January '83 issue (*Solar Systems And Heat Pump Combine To Cut Energy Bills*, page 92). The bottom line: I cut my electric bills during the summer of 1982 by \$35 or more per month—something that you can do as well.

For 20 years, I've been on a flat monthly payment schedule with the electric company. We reconcile each October. In the past, I've owed something and usually increased my monthly budget amount. Last fall, however, I received a refund check for \$146.23 and reduced my monthly payment by more than 20 percent.

Another refund came in taxes. The 40 percent solar energy tax credit amounting to more than \$1,400 on line 47 of



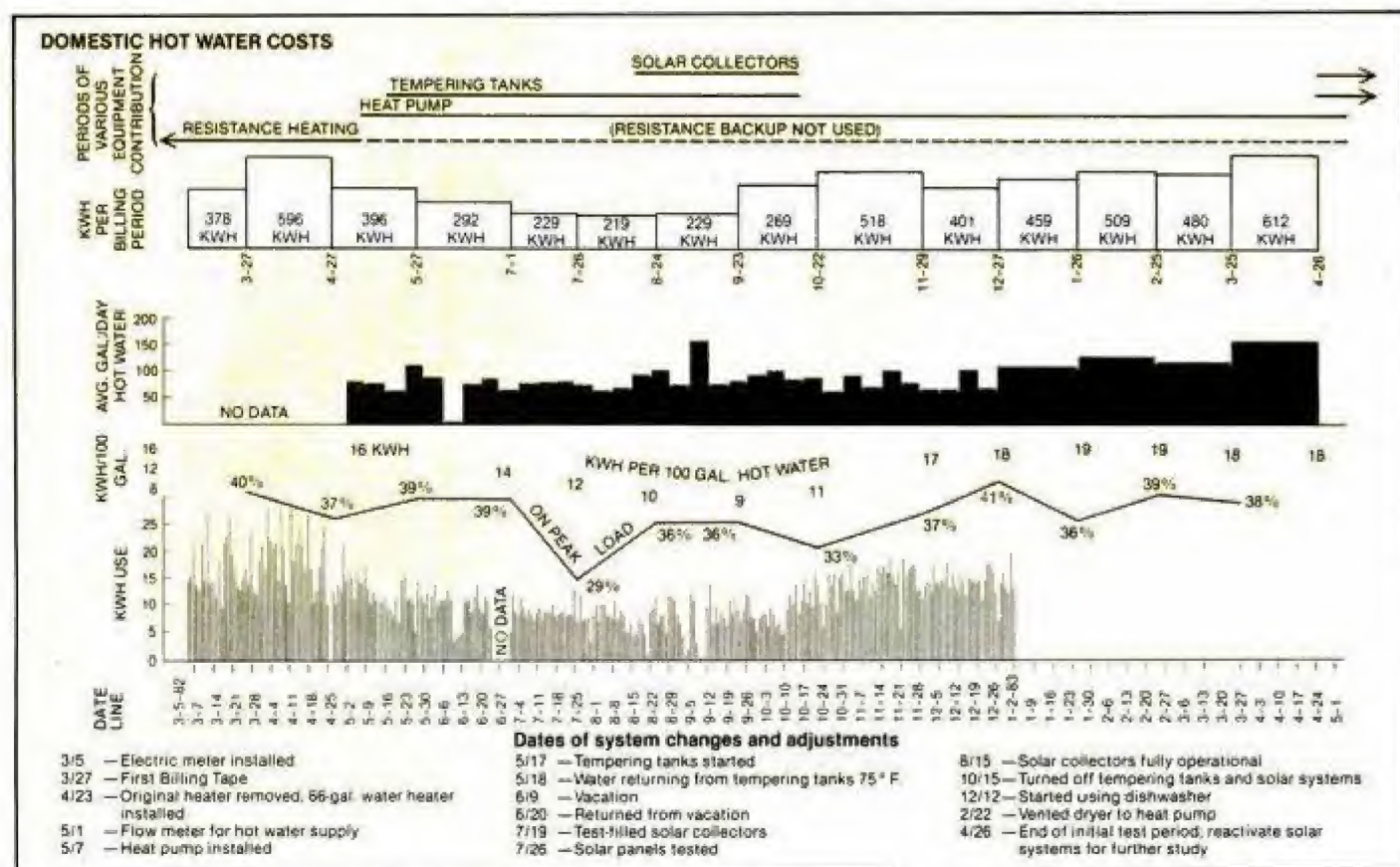
Hot-water supply from the softener is measured with a flow meter. In summer, the solar push-pull valve (arrow) diverts well water to tempering tanks before entering water-heating equipment. Thermometer shows temperature of water from tempering tanks. On average, water is raised from 55° to 75° F.

my 1040 form for 1982 made it possible. The credit was for expenditures for Mor-Flo's solar kit, miscellaneous plumbing and electrical materials.

Our utility company rates are higher than average in summer and lower than average in winter. They are designed to encourage a reduction of the summer peak load. My decision to use solar equipment in the summer was in response to this incentive program. My apparent kilowatt-hour savings alone during the start-up summer was about 36 percent.

Heat pump results

After putting in a larger 66-gal. water storage tank, the first step to cutting water heating costs was to install an add-on heat pump. Reviewing the computer printouts of kilowatt demand issued every half hour, I was surprised to see



A recording demand meter, installed prior to any changes, provided data for measuring savings from each component. Electric meter and water-flow meter measured hot water that passed through the components and provided basic data for

the chart. Information was analyzed by computer to provide off-peak data and typical daily and weekend load profiles for each month. Thermometers provided temperatures of water returning from tempering tanks and solar panels.

that the electric resistance backup unit never was used.

When it's cool in the basement area, the heat pump works longer to raise the water temperature. In colder winter months, the kilowatt demand is lower but the kilowatt-hour usage remained up (see chart). I always have run two dehumidifiers in my basement to keep my workshop and office dry. This year, I turned them off. The heat pump did the job better.

This past February I changed the venting of our clothes dryer so waste heat was directed down near the heat pump instead of outside. I believe this explains the 5 percent efficiency improvement in the heat pump from 19 to 18 kilowatt-hours per 100 gallons of hot water during March and April.

Tempering tanks in the attic

The next components we installed were two 30-gal., glass-lined tempering tanks. Since this is a passive solar system, the tanks were set up in the attic to take advantage of the heat there. Like the heat pump, they don't qualify for a tax credit. However, I expect no maintenance costs for the tanks and plumbing. There are no electrical parts. I push a solar valve to activate the system in spring and to drain it in fall. Water coming from our well merely is diverted in summer to the attic tanks, where it picks up heat. Water temperatures coming down average 75° F. In midsummer, a valuable 20° rise.

The tempering tanks don't depend on the sun's direct heat, so they work rain or shine, as long as their temperature is above that of ground water. Raising ground water temperature by 20° F. works out to be worth 2 to 3 kilowatt-hours a day. I estimate that the two tanks are saving at least \$6 a month, possibly as much as \$9 during the hottest weather.

Solar collectors

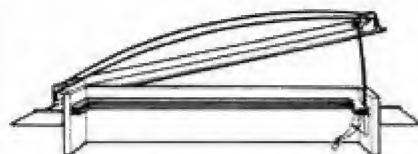
Mor-Flo's double-glazed solar collector panels proved to be fine equipment. They survived the winter unscathed. Start-up this spring was smooth and trouble-free. By mid-morning, when the sun was shining, the water temperature returning from the rooftop collectors averaged 130° F. Sometimes, it's as much as 145° to 150° F. The system is quiet and efficient.

We had an unusually early, cold fall that crimped my measurements. However, the short period of use indicates that solar collectors provide about a 25-percent reduction in electric usage.

Still, solar is a rather difficult financial choice. If payback appears to be 20 to 25 years, there is no way to know what economic changes may come along. However, my system has saved me money.—David A. Warren



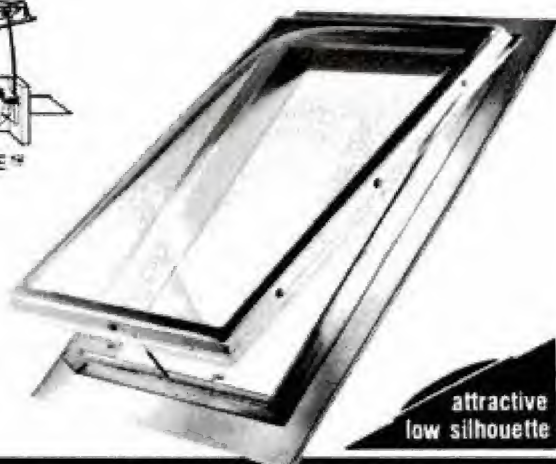
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83 HOME ENERGY GUIDE

Repairing Broken Windows



Measure the sash frame's inside dimensions for the replacement pane. If the cracked pane remains intact, as shown here, you simply have to measure the broken pane.



To disassemble the sash, remove four corner screws that hold the frame together. Screw locations may differ a bit depending upon the sash manufacturer.



After removing the corner screws, pull loosened glass splinters free. Be sure to wear gloves. Remove large pieces of glass after the frame is pulled apart.

You've put it off long enough. Now, with autumn approaching, it's time to finally repair that shattered storm window. Our do-it-yourself, step-by-step instructions will help you do this task faster than you might expect. Also, we show how to lower your home heating

bill a bit by replacing the broken pane with a low-iron, high-energy glass.

Solakleer, the glass used here, is from General Glass International Corp., 542 Main St., New Rochelle, N.Y. 10801. It is claimed to have 50 percent less iron content and a higher solar



Separate frame members by tapping the protruding spring-loaded latch with a wood block or rubber mallet. Be sure to keep a firm grip on large glass pieces.



Carefully remove the old rubber spline from the broken window pane. If the spline isn't ripped or corroded, you can reuse it. Otherwise, you must replace it.



Start the spline midway along the edge that will be used at the top of the window. At corners, cut halfway through spline so that it makes these turns smoothly.

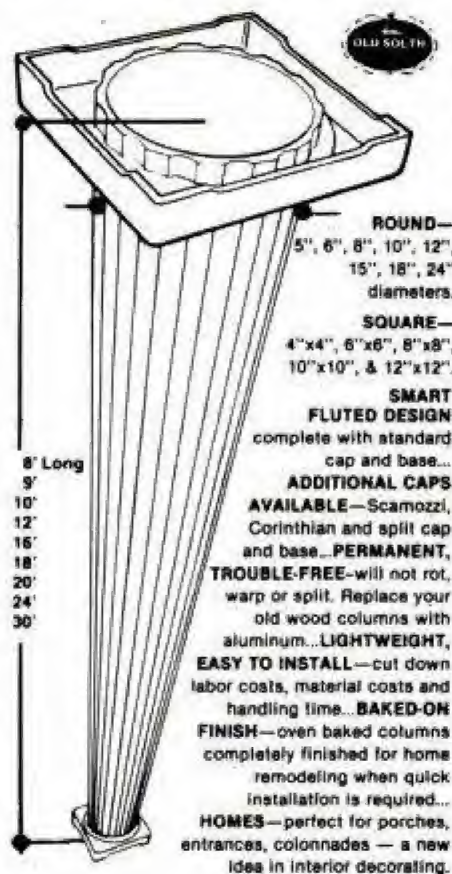
transmission rate than conventional glass. Although it looks, performs and costs about the same, Solakleer admits about 16 percent more sunlight and 25 percent more B.T.U.s, according to the maker.

Whatever type of replacement glass you choose, be sure to handle it with

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83 HOME ENERGY GUIDE

care. Be firm but gentle, and always wear safety goggles and leather gloves when cutting and handling it.

Tools you'll need

A few standard hand tools are all that are required to repair a broken window-pane. A rubber or plastic mallet and a wooden block are needed to tap apart the sash frame members. Cutting pliers or snips are used to cut the rubber spline so that it fits tightly around the glass pane.

In addition, you'll need a screwdriver and a tape measure. If the old rubber spline is split or corroded, now is the time to replace it. New splines are available at hardware stores or glass dealers.

Removing the storm sash

The first step is to carefully remove the aluminum storm sash, with the broken pane, from the window frame. *Caution:* Lift the sash out while wearing gloves and goggles. Jagged glass fragments are jarred free from the sash frame easily.

Next, determine what size replacement glass is needed. Measure the

sash frame's inside dimensions, including the support lips on which the glass pane sits. If you're unsure of the correct measurement, bring the sash with you when you order its replacement pane. An experienced glazier can determine the correct pane size from the sash frame.

PM



Slide the end tab of the bottom frame member into its mating slot. Remember to use the frame member with the spring-loaded latches at the bottom.



Where necessary, use a screwdriver to tuck the spline beneath the frame. This will improve the window's appearance and also help to prevent any leaks.



Continue installing the spline around the entire pane. When you reach the starting point, cut off the excess spline to ensure forming a tight-fitting butt joint.



Use a plastic or rubber mallet to tap each frame member onto the new pane. The correct sequence for reassembly is: side, top, side and bottom.

After you replace the corner screws, the sash can be reinstalled. But, first clean the window tracks of all debris. Then, spray with a silicone lubricant.

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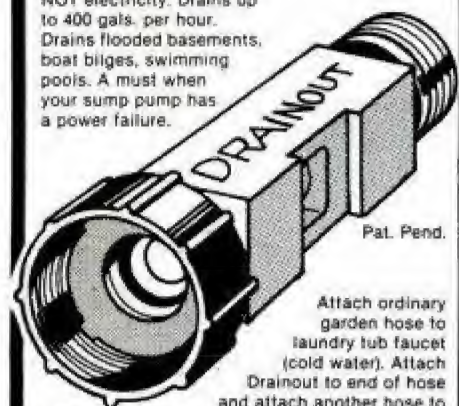
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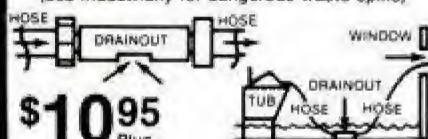
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'83 HOME ENERGY GUIDE

Auditing Your Home Energy 'Books'

Free or inexpensive home energy audits are being offered by more than 300 utility companies in 30 states under the Energy Policy and Conservation Act of 1978. It is hoped that the energy conserved as a result of these audits will help cut residential fuel usage 30 percent by 1985, the year the law expires.

Your local utility company can tell you whether audits are available in your area and where to obtain an application form. If there is a cost, it cannot be more than \$15, the maximum allowed to utility-sponsored inspectors by the law.

After a thorough inspection of the physical characteristics of your house, you receive a computer printout detail-

ing what can be done in your home to save energy. A typical printout (see below) lists modifications, dollar savings in the first year and return on investment. Costs are based on surveys of suppliers and contractors in your area.

The inspector carries a computer terminal which taps into a central computer via a toll-free telephone line. The master computer has access to the record of your utility bills, assuring a sound basis for comparative savings.

We recently followed an inspector from DMC Energy Inc., one of about three major national companies doing energy inspections, on an examination of an older house located in northern Illinois. The printout shown is from this inspection. Briefly, this is what he did in his thorough, 90-minute audit:

First, the inspector used a solar sighting device to determine the feasibility of solar applications. He measured the house exterior, made a drawing of the walls and drew in windows with mea-



When aimed due south, solar sighter with graph, level, compass and lens helps determine the feasibility of solar aids. Graph shows path of sun and notes areas where its rays will be blocked.



Holes in the envelope of the house where gas and electric lines enter are located. These should be caulked both on the exterior and interior to save energy.

ENERGY AUDIT

Measure	Installation Cost (\$)	First-Year Savings (\$)	Years To Payback
Frame wall			
Insulate to R-11			
Contractor	961-1,053	157-192	6
Masonry wall			
Insulate to R-11			
D-I-Y	309-378	106-129	3
Contractor	638-780	106-129	7
Basement wall			
Insulate to R-11			
D-I-Y	309-378	17-20	19
Contractor	638-780	17-20	25+
Ceilings under attic			
Insulate to R-30			
D-I-Y	94-114	11-13	9
Contractor	271-331	11-13	25+
Weatherstripping			
D-I-Y	84-126	20-30	5
Contractor	438-657	20-30	22
Clock thermostat			
D-I-Y	42-64	59-89	1
Contractor	68-102	59-89	2
Automatic vent damper			
Contractor	134-164	85-104	2
Intermittent ignition			
Contractor	189-284	19-28	11
Replace gas furnace*			
Contractor	612-917	132-197	5
Solar domestic hot water orientation**			
D-I-Y	1,337-1,635	37-46	25+
Contractor	2,439-2,982	37-46	25+
Passive solar sunspace			
D-I-Y	3,726-4,554	88-107	25+
Contractor	5,725-6,997	88-107	25+
Thermosiphon air panel			
D-I-Y	1,402-1,714	22-27	25+
Contractor	1,893-2,313	22-27	25+

*B.T.U./hr.: Input-98,000; output-72,000. Seasonal energy efficiency ratio as found; 57%; new: 73%.

**Preferred collector area: 41 sq. ft. Percent of energy supplied: 70%. Tank size: 66 gal.

surements, noting any storm windows.

Next, he checked the house inside and out for leaks in the envelope. He checked around windows and doors, and around pipes and wires entering the building.

In the basement, he noted a potential savings, however small, by installing insulation on the inside of the concrete walls. The auditor suggested replacing an older furnace that had been converted from coal to oil, and then to natural gas, with a new, more efficient gas unit. He also took samples of combustion gases and made a temperature check of the old unit.

In the attic, the auditor discovered



A sample of combustion gases and temperature of the furnace are taken. Information goes into computer for analysis.



Receptacle plate is removed inside an exterior wall, then wall is probed with a wooden dowel to check for insulation.

there were no vents, so humidity from the house air was trapped. The vapor barrier on some blanket insulation was positioned incorrectly on the top side, trapping humidity in the insulation.

Finally, the inspector checked the interior walls by removing an electrical cover plate. He discovered that there was no insulation in the walls.

Besides printout information, the homeowner received a conservation kit filled with tips, and a list of local suppliers and lenders.—William Beyer

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The majority of wood- and coal-stove users who are safety-conscious install a smoke alarm. This is a wise move, of course, but remember that a smoke alarm will be triggered only after a fire has already started.

It's common knowledge that the temperature in the stovepipe can rise high enough to ignite the creosote that builds up in a flue.

This can result in a chimney fire (see *New Wood-Stove Tests Yield Surprising Facts About Creosote*, page 116, Sept. '81), which will turn the stovepipe into a blast furnace.

Vermont Technology's Chimney Fire Alert has a sophisticated electronic cir-

cuit that monitors temperature in the stovepipe.

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The device is easy to install. Once

inserted into the stovepipe, the thermocouple is attached with two sheet-metal screws. The battery-operated monitoring unit can be attached to the wall or placed on the mantle.

Available at stove and hardware stores and by mail for \$49.95, the alarm is made by Vermont Technology Group Inc., RFD No. 1, Dept. PM, Morrisville, Vt. 05661.—Rosario Capotosto



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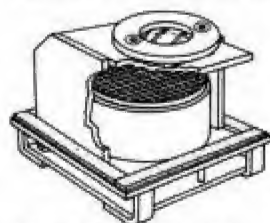
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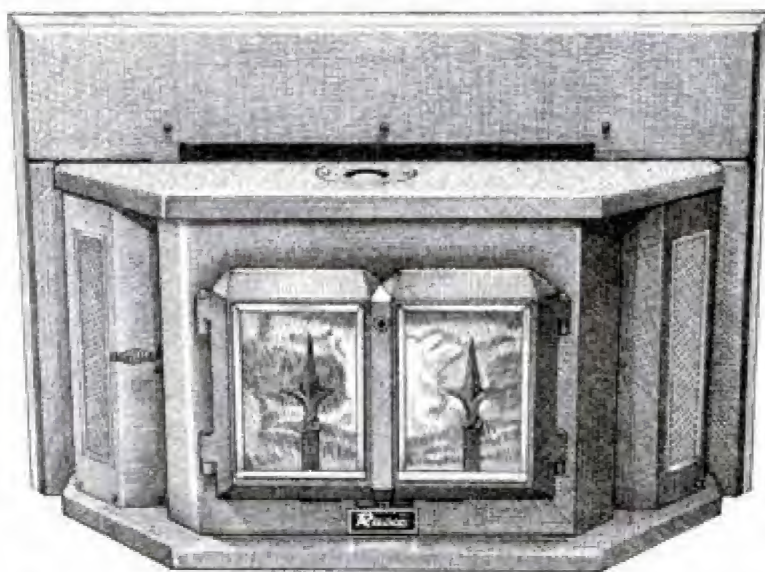
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Pest Control Division

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How To Season Firewood



Solar dryer with fiberglass top, particleboard base costs \$40 to build, holds one cord.

To achieve maximum efficiency when burning firewood, it must be properly seasoned. Thus, researchers at the U.S. Department of Agriculture's Forestry Sciences Lab conducted a study to find the best way of seasoning wood to the ideal 20 percent moisture content. Freshly cut hardwoods have a moisture content ranging from 30 to 55 percent. The researchers tested eight factors that might affect drying time: cutting season, tree species, log length, splitting, stacking method, exposure (in the woods or in the open), cover and solar assistance. This is what they found out:

Wood cut in the spring, then dried for six months, was only 1 percent wetter than autumn-cut wood seasoned for 12 months. In other words, wood cut around the first of June will be ready for October burning. Dense woods, such as hickory, dried more slowly than light woods. Sugar and red maple were the driest species after 12 months (see chart). Shorter pieces dry slightly faster. Splitting wood was a definite help, yielding 2 to 3 percent more dryness.

Log-stacking formation—parallel versus crisscross—made no difference. On the other hand, wood that was cov-

ered usually seasoned better than uncovered wood. Tarpaper-covered wood dried equally well in the woods and in the open.

Two solar drying devices were also tested. A simple cover of clear fiberglass with a black particleboard base (top photo) produced firewood up to 3 percent drier than wood covered with tarpaper. Another unit (photos below) dried wood twice as fast. Two summer months in the unit were enough to dry firewood to 19 percent moisture content.—Jeffrey L. Wartluft, Forest Services, Princeton, W. Va.

PERCENT OF MOISTURE— FIREWOOD

Species	Fresh Cut	Seasoned*		
		12"	18"	24"
Ash	31	20	21	24
Beech	42	25	23	23
Birch	40	26	22	23
Black cherry	35	26	22	24
Hickory	32	25	26	26
Red maple	35	13	14	15
Red oak	39	20	22	24
Sugar maple	36	20	19	19
White oak	38	19	23	26
Avg. for all	36	22	21	23

*After 12 months of drying.



Logs being seasoned rest on 4x4 skids in 2x4-framed, plywood-sheathed dryer (above). Interior is flat black and top exterior is white. The front is covered by clear plastic (right). Materials cost \$80.



Pall Mall A Step Ahead

Step up in taste,
step down in tar



9 mg. tar
0.8 mg. nic.

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

9 mg. "tar", 0.8 mg. nicotine av. per cigarette, FTC Report Mar. '83.

Build your own air compressor from PM's plans



Once you have an air compressor in your home shop, you'll wonder how you ever got along without it. You can spray paint with it. You can inflate swimming gear, toys, auto and garden tractor tires. More important, you can sandblast parts and rivets in metal seams. You can blow-clean fine mechanisms and, with PM's unit you can vacuum pump your car's airconditioning system prior to adding Freon—something you can't do with most ordinary air compressors. Finally, this unit features a filter/water trap—which is an optional extra on most commercial air compressors.

PM AIR COMPRESSOR

You can do all these things with this versatile 1-hp compressor and, happily, you can build it for less than \$200.

PM

Compressor evacuates car's airconditioning system prior to adding new refrigerant (far left). At left, routine inflation of tires saves trip to gas station.

HOW TO ORDER PLANS

Send check or money order for \$5.95 to Air Compressor, Popular Mechanics Plans Library, Box 1014, Radio City Station, New York, N.Y. 10101. Allow two to three weeks for delivery; for first-class mail send 75 cents extra.

Popular Mechanics is a publication of Hearst Magazines, a division of the Hearst Corporation.

83 HOME ENERGY GUIDE

New Ways To Save Energy



This simple tool provides an accurate solar evaluation of your home or building site. By simply looking through the Solar Card, a transparent sheet that's marked with the sun's path for each month, you can see which objects shade the prospective building site at various times of the day and year. Since the sun's path varies at different latitudes, specify your nearest latitude when ordering the Solar Card, or include your ZIP code and the manufacturer will determine your latitude. The Solar Card sells for \$12.95 postpaid and is available from Design Works Inc., Box 489, North Amherst, Mass. 01059.



The Super Saver shower head (\$12.95) is claimed to use only 2 gal. of water per minute at 45 p.s.i. A standard shower head uses as much as 8 gal. of water per minute. The result is a water savings that could be as high as 60 to 70 percent. The Super Saver has two spray actions and comes with easy do-it-yourself installation instructions that require no tools. For details and further information, contact Teledyne Water Pik, 1730 East Prospect St., Fort Collins, Colo. 80525.

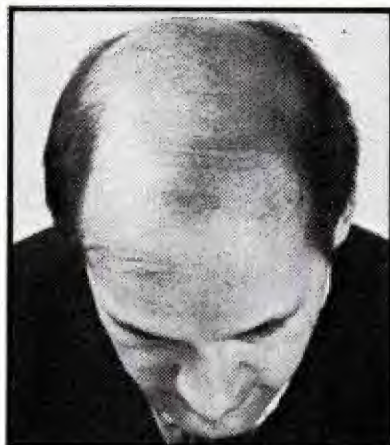
(Please turn to page 126)

Bald? Thinning? Worried? Read...

"BALDNESS CONQUERED"

Medical Breakthrough Successful In More Than 95% Of All Cases!

by Michael J. Ross, noted Researcher & Hair Therapist



Dear Friend,

It was with great pleasure that I answered an invitation to bring you news of a remarkable breakthrough for baldness:

A triumph of what I believe can be called nothing less than surgical skill and daring imagination, combined in a program that has been tested on over 1000 fortunate men who needed our help... and could afford the enormous cost of attending our private clinic. In fact, since I was involved in its development from the very beginning, I am pleased to announce that now...

• IF YOU ARE BALD • IF YOU ARE CONCERNED ABOUT EXCESSIVE PREMATURE HAIR LOSS

OUR HAIR SUPPLANTATION PROGRAM OFFERS YOU A WAY TO ACTUALLY REVERSE THE SHAME AND SUFFERING OF BALDNESS FOREVER!

Even if you are completely bald... even if you haven't had a strand of hair on your scalp in 20 years... with our HAIR SUPPLANTATION PROGRAM you can look strong, virile, and desirable again... with hair that commands respect, the kind of hair women love to run their fingers through.

15 YEARS OF HAIR RESEARCH AND OVER \$10 MILLION SPENT IN SEARCH OF AN ANSWER TO BALDNESS

My HAIR SUPPLANTATION research began more than 15 years ago in England where I worked with some of the most respected hair therapists and practitioners in all of Europe. To be fair, some people don't consider baldness a major problem, but you wouldn't know it from talking to most men who are bald, going bald, or worried about losing their hair. To these men loss of hair means untimely aging, endless embarrassment, problems with confidence, and ultimately, depression... which is why no less than \$10 MILLION has been invested worldwide by many independent companies and researchers in the BATTLE AGAINST BALDNESS. On both sides of the Atlantic, doctors, chemists, and biologists joined the work...

THEN CAME THE BREAKTHROUGH: OVER 95% SUCCESS IN SUBJECTS WITH MALE PATTERN BALDNESS!

Thanks to the tireless efforts of dedicated researchers and the selfless courage of early test subjects—the mystery of HAIR SUPPLANTATION was unraveled. At long last we had found the power to stop the tragedy of baldness in its tracks and help almost any man to a bright new beginning—from 25-year-olds with slightly receding hairlines to middle-aged men with just a horseshoe of hair left on their scalps. With years of development and testing... our research was proven out. And among men who have visited our clinic in New York City—even those with so-called "irreversible" male pattern baldness—we have achieved a consistent success rate of over 95%.

THE HAIR SUPPLANTATION DISCOVERY: A PATENTED MEDICAL COMPOUND

With positive results in over 1000 cases, our key HAIR SUPPLANTATION discovery is a medical compound, developed and patented by a major unaffiliated drug company. The miracle is that its use in the HAIR SUPPLANTATION process was entirely unforeseen until our testing began. It works by clinically preparing the scalp (without chemical irritants or dangerous hormones) to provide an environment where HAIR SUPPLANTATION can occur... safely and naturally. Though as one client puts it, the HAIR SUPPLANTATION PROGRAM is

"simplicity itself", the biological mechanisms involved are too complex to be adequately explained in this limited space. I have therefore authorized a detailed, step-by-step, photo-illustrated report, titled **BALDNESS CONQUERED**, on the HAIR SUPPLANTATION PROGRAM and the research effort for an ANSWER TO THE PROBLEM OF BALDNESS, now available to those who wish to see the POSITIVE PROOF in the privacy and comfort of their homes... without the expense of traveling to New York for a private consultation.

NEW! FOLLICIN-NH3 PREPARATION FOR HAIR

FOLLICIN-NH3 Preparation For Hair has been specially formulated to provide scientific support for continued normal hair growth, hair nourishment, and hair maintenance. Applied directly to the scalp—where it is needed most—FOLLICIN-NH3 is "function specific" micro-nutrient group works quickly to promote essential biological activity... while the FOLLICIN-NH3 regimen help insure that hair follicles are properly serviced by the microscopic capillaries that carry the chemical building blocks necessary for BEAUTIFUL HAIR. FOLLICIN-NH3: Quite simply, it's got what you need to insure a beautiful, HEALTHY HEAD OF HAIR!



NOW AVAILABLE TO THE GENERAL PUBLIC!

Through a special arrangement with a national maker of Hair Therapy products, we are now making the SECRETS OF HAIR SUPPLANTATION available to the general public. This marks the very first time we have agreed to reveal the program successfully tested on over 1000 bald and balding men at our exclusive clinic. Because we firmly believe that knowledge of THE ULTIMATE ANSWER TO BALDNESS should not be limited to the privileged few.

WHO HAS USED HAIR SUPPLANTATION?

Men of all ages, but mostly affluent ones since the program was designed to be administered by highly paid doctors and hair therapists... with treatments costing \$2,000, \$3,000, \$4,000 and more. But what all these men had in common was that they had tried

everything TO GROW NEW HAIR... every pill and lotion on the market. Many were completely bald. Others found that day by day, strand by strand they were losing their hair... and nothing seemed to help. Yet today, almost every single one of these men enjoys A FULL HEAD OF HAIR. They include:

**FAMOUS MOVIE STARS • POLITICIANS • DOCTORS
• LAWYERS • YOUNG MEN • OLD MEN
• MEN FROM EVERY WALK OF LIFE**

We can't name names in print (though you will receive signed and notarized proof of a list of famous satisfied customers with your order), but we can tell you that you would recognize their names instantly, know their faces from newspapers and T.V., and be astounded at how great they look... thanks to the miracle of HAIR SUPPLANTATION. And these are men who came to us full of despair, desperate for A BALDNESS SOLUTION.

STANNIS RESEARCH INTERNATIONAL, DEPT. SP-282
18 W. 27 STREET, NEW YORK, N.Y. 10001

☐ Please send me my FREE copy of **BALDNESS CONQUERED**. And RUSH me the supply of FOLLICIN-NH3 checked below.

☐ 1 MONTH SUPPLY OF FOLLICIN-NH3:

\$45 plus \$2 shpg. & hndlg. (Total \$47)

☐ SAVE \$14—2 MONTH SUPPLY OF FOLLICIN-NH3:

\$80 plus \$3 shpg. & hndlg. (Total \$83)

☐ SAVE \$27—3 MONTH SUPPLY OF FOLLICIN-NH3:

\$110 plus \$4 shpg. & hndlg. (Total \$114)

☐ SAVE \$122—RECOMMENDED 6 MONTH SUPPLY OF FOLLICIN-NH3: \$160 (We pay shpg. & hndlg.)

Total Enclosed \$ _____ (N.Y. res. add sales tax)

☐ Visa ☐ Master Charge (Bank # _____)

Account # _____

Expiration Date _____

Name _____

Address _____

City _____

State _____ Zip _____

SATISFACTION GUARANTEED OR YOUR MONEY BACK

Use FOLLICIN-NH3 for a full 6 months. You must be completely delighted or simply return empty bottles for a prompt, full refund... no questions asked.

Manufacturer's Note: While initial results are often seen in 30 days or less, for maximum effects our researchers recommend the daily use of FOLLICIN-NH3 for a full 6 months.

MUST LIQUIDATE Catalytic Wood Stove

At FAR BELOW dealer cost! And even BELOW manufactured cost!

FACTORY NEW! FACTORY PERFECT!

First it burns the **WOOD!**
Then it burns the **GASES!**
Catalytic converter, with precious **Palladium and Platinum**, helps produce amazing **86-90% efficiency!** It's the **BEST** you can buy!

Here's your "buy of a lifetime" on a superb stove! It's the SAME model that sold in major chain stores for over \$700 MORE than OUR low liquidation closeout price!

3 Combustion Stages!

Highly advanced design provides primary and secondary combustion stages... plus a **THIRD** stage! The third stage utilizes scientific catalytic action to produce burning efficiency that is extremely high!

Catalytic System!

Precious palladium and platinum are used in a catalytic coating on a ceramic "honeycomb" afterburner. This reduces normal high ignition temperatures of waste gases so they can be burned for **EXTRA** heat. You get **MORE** heat from **LESS** wood!

No Creosote Problems!

Because most of the waste gases are burned up, hazardous creosote buildup is virtually eliminated. The chimney stays very clean. About all that goes up the chimney is harmless carbon dioxide and moisture.

This remarkable stove even provides high efficiency with cheaper softwoods and partially seasoned wood. (MORE savings for you!)

Primary intake of room air can be precisely adjusted. Automatic bypass provides safe, smoke-



**Up to 160,000 BTU
Fuel Value Per Load!**

free startups and refueling. Pre-heating of air in a manifold maintains necessary temperatures for complete combustion.

- Double wall construction gives more effective insulation.
- 1/4" steel plate construction for fast heatup; rugged durability.
- A **THIRD** wall around 2/3 of the stove for **EXTRA** insulation and convection heat.
- Calibrated control lever for precise increments of room air to be drawn into manifold for desired temperature control.
- Viewing porthole lets you monitor Catalytic System to see if any minor adjustments are desired.
- Burn time can be increased by "slowing down" fire and **STILL** keep almost perfect combustion.

**Now SAVE Over \$700
Due to Financially
Distressed Inventory!**

One of the nation's largest manufacturers of stoves made this advanced design under a private label for a marketing firm. The marketing firm ran into financial difficulties, so the manufacturer refused to deliver this shipment.

The manufacturer finally decided to liquidate this inventory **AT A LOSS!** Now you can get a terrific bargain... **AT BELOW MANUFACTURED COST**... and save many hundreds of dollars!

**Manufacturer's
Suggested Retail
\$1199.00
OUT THEY GO AT ONLY:
\$488**

Offer void outside continental U.S. Be sure you have enough people to unload the wood stove upon delivery. Price subject to change after 60 days.

Color: Black body & doors

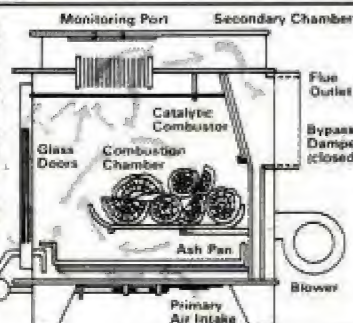
Avg. heat output 64,000 BTU/hr
Fuel value per load 160,000 BTU
Burn time 8 to 10 hours
Size 28"H x 30"W x 23 1/2"D
Weight approx. 380 lbs.
Flue diameter 8"
Height to flue bottom 15 1/2"
Door opening 14" x 22"
Catalytic combustor 2600°F rated
Log size capacity 24"
Fire box size 17"D x 25 1/4"W
Heating capacity 10,000 cu. ft.
Ash pan ... heavy-duty, removable
Wood grate ... heavy-duty cast-iron

Safety approvals: Tested to UL standards by the Gas and Mechanical Laboratories. ICBO listed on report No. 3558.

Super efficient Catalytic System lowers ignition point of escaping gases from 1300°F range to about 500°F. This allows stove to burn gases as fine fuel for **EXTRA** heat! You get more BTU with less wood.

With primary and secondary air controls, the air and fuel ratio can be kept near perfect for both high and low fires.

Gasketed air-tight doors have inner AND outer panels of hi-temp glass for insulation. Special inlet under hearth is safety feature to extinguish fire in stove if Catalytic System clogs due to improper usage.



For name of the major U.S. stove manufacturer... and for full factory warranty details, call Toll-Free.



VISA **MasterCard** **AMERICAN EXPRESS** **Diners Club**

Credit card customers can order by phone. 24 hours a day, 7 days a week.

Toll-Free: 1-800-328-0609

If busy signal or if no answer, call:

Toll-Free: 1-800-328-5727

In Minnesota call: **1-800-742-5685**

C.O.M.B. Co.

THE NATION'S LARGEST AUTHORIZED MAIL ORDER LIQUIDATOR OF CONSUMER PRODUCTS
6850 WAYZATA BLVD. • MINNEAPOLIS, MN 55426

C.O.M.B. Co. / Liquidators Dept. F-116-9231
6850 Wayzata Boulevard / Minneapolis, Minn. 55426

Send _____ Wood Stove(s) at \$488 each. I will pay the shipping charge to driver upon delivery. (Allow 4-5 weeks for delivery. Add 2-3 weeks extra if paid by check. Sorry, no C.O.D. orders.)

Minnesota residents add 6% state sales tax.

☐ My check or money order is enclosed.

Charge my: ☐ MasterCard® ☐ VISA ☐ Am. Ex. ☐ Diners Club

Acct. No. _____ Exp. _____

PLEASE PRINT CLEARLY

Name _____

Address _____

City _____

State _____ ZIP _____

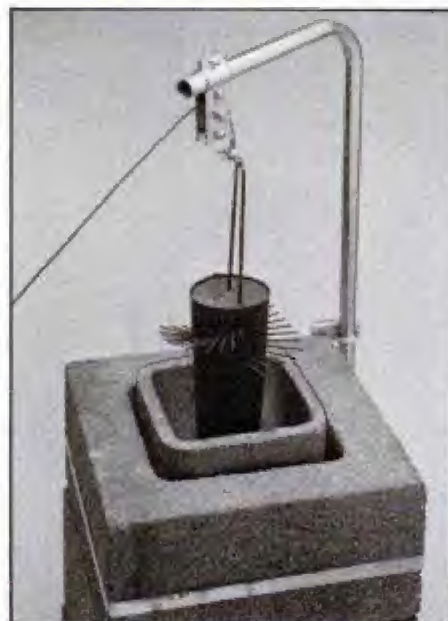
Phone _____

Sign here _____

Rural Route Customer: If truck carriers do not normally deliver to your home, include note with this order, stating town address of nearest store, friend or truck terminal to ship to.

83 HOME ENERGY GUIDE

(Continued from page 124)



Here's a chimney cleaning system that you operate while standing safely on the ground. The Chisler chimney cleaner is banded to the chimney top. The unit consists of a cleaning head attached to a combination cable/rope line. As the cleaning head (a 10-pound weight studded with wire picks) is hoisted up and down, caked-on creosote and soot are picked from the chimney liner. The Chisler is available unassembled for \$60, which requires mixing concrete for the weighted head, and fully assembled for \$100. It's made by N.A. Taylor Co., 10 West Ninth Ave., Gloversville, N.Y. 12078.



Half-inch gypsum board and polystyrene foam are bonded together to form Styro-liner wall panels. The 4 x 8-ft. insulating panels are installed using conventional drywall methods. Panels are available with 3/4, 1, 1 1/2 and 2-in.-thick polystyrene backing. Prices range from 49 cents per sq. ft. for 3/4-in. foam panels (1 1/4-in. O.A.) to 90 cents per sq. ft. for 2-in. foam (2 1/2-in. O.A.) panels. The panels are manufactured by Spirex Structures Inc., 21750 Schmemman, Warren, Mich. 48089.



The Neuman universal chimney cap (\$31.95) fits 23 different-size chimneys. The heavy-gauge steel cap keeps rain and snow out to protect metal stovepipes, dampers and wood stove inserts. When used with the screen (included), the cap prevents birds and squirrels from entering the chimney and also acts as a spark arrester. Contact Neuman Chimney Cleaner, Box 546, Ogema, Wis. 54459.



The Preway vent-free Patriot gas heater provides low-cost, soot-free heating without expensive ductwork. Preway vent-free heaters are available in four capacities: 10,000 B.T.U. (\$220), 15,000 B.T.U. (\$255), 25,000 B.T.U. (\$298) and 30,000 B.T.U. (\$314). An optional blower is available for \$85. For more information, you should contact Preway Inc., 1430 Second St. N., Wisconsin Rapids, Wis. 54494.

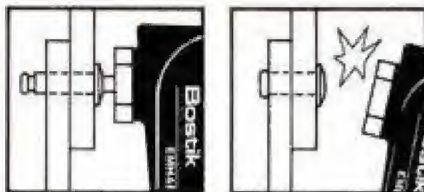


AMF introduces the Qwaterback II (\$69.95) time control for gas water heaters. The Qwaterback II cuts hot-water costs because it automatically operates the water heater at programmed times. For more information, you should write to Marketing Communications Manager, AMF Paragon Electric Co., 606 Parkway Blvd., Two Rivers, Wis. 54241.

(Please turn to page 126)

POP[®] RIVETOOL. Whenever nuts and bolts aren't holding their own.

- Easy to use—POP[®] brand Rivets fasten two surfaces from one side in seconds, permanently.
- POP brand Rivets won't strip, can't shake loose like screws, nuts and bolts.



Rivets insert easily, even when working from one side. When end is fully expanded, rivet stem pops and rivet locks in place permanently.

- Hundreds of uses inside and outside. Lets you: assemble gutters; install downspouts; make auto repairs, customize cars and vans; fix lawn furniture; repair storm doors, leather goods and much more.
- Fastens metal, wood, cloth, plastic, leather, etc.
- Ideal for year-round gift giving.
- Available wherever hardware is sold.



Bostik
CONSUMER DIVISION

Reading, PA 19605

EMHART

A trigger-squeeze breeze
in the hands of the
handy homemaker!

A powerful, useful tool
in the hands of the
home handyman!



ARROW
ELECTRO-MATIC

Model ET-50 ELECTRIC STAPLE GUN

It's **TRIGGER-FAST!**
Just plug in... and **SHOOT!**

Just plug it into standard house current... and you're ready to fire staples as fast as you can squeeze its feathertouch trigger!

With her lightweight, trigger-fast Arrow ET-50 Electro-Matic, the handy homemaker will breeze effortlessly through scores of light decorating and repair chores... trimming a kitchen shelf, lining a closet, mending a torn screen or covering a headboard.

And, the Arrow ET-50 Electro-Matic is a fastening tool with the heavy duty staple-driving power the home handyman needs for putting up ceiling tile, installing insulation, applying weatherstripping, etc.

Uses Arrow No. T-50 staples exclusively, in 6 sizes: 1/4", 5/16", 3/8", 1/2", 9/16" and Ceiltile.

Available at all leading Hardware,
Home Center & Discount
Department Stores everywhere.

ARROW FASTENER COMPANY, INC.

271 Mayhill Street, Saddle Brook, N. J. 07662

Operates
on any
110 Volt
AC-60 Cycle
Outlet.

NEW!

**Low-cost logsplitter
kit splits 24" logs
with 10-ton punch!**

The Heald Woodhog kit goes together in a jiffy to of the most powerful and reliable logsplitters on the Gutsy 5-hp Briggs & Stratton engine powers the 4" ram to split up to 24" logs with a 10-ton punch. Shown here for towing to on-site locations with Heald Hauler or any of a complete line of off-road vehicles sold by Carl Heald in money-saving kit form. Kit priced from just \$599.95

For **FREE** brochure call **TOLL FREE 1-800-253-1030**; in Michigan call 616/849-3400 or write:

CARL HEALD, INC. Dept. NDR, P.O. Box 1148, Benton Harbor, MI 49022



give you one
market today.

cylinder hydraulic
with optional road pack-

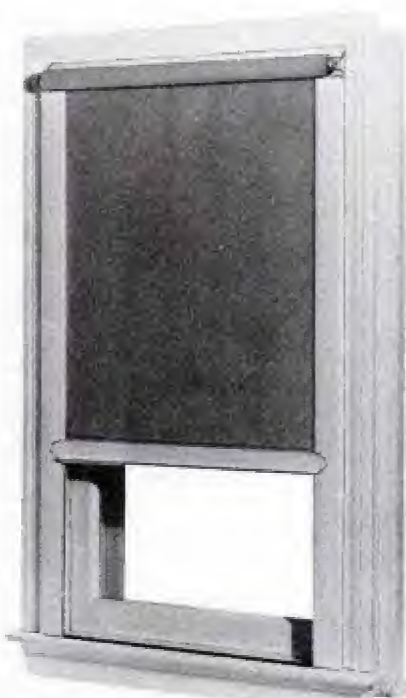
age for towing to on-site locations with Heald Hauler or any of a complete line of off-road vehicles sold by Carl Heald in money-saving kit form. Kit priced from just \$599.95

'83 HOME ENERGY GUIDE

(Continued from page 127)



Here's a new energy-efficient pleated shade by Verosol Inc., 224 Park West Dr., Pittsburgh, Pa. 15275. Woven polyester is bonded with a thin layer of aluminum to act as a sun screen in the summer and as an insulator during the winter. The shades are available in three fabric densities: transparent, semi-opaque and a totally private fabric. Prices for the shades range from \$6 to \$7 per square foot.



The Wind-Stop shade slide works in conjunction with an existing window shade to lock out cold air. Simply attach the extruded PVC assembly to the window frame. Then, insert the shade into the appropriate slot and pull it closed. Wind-Stop comes in two sizes that can be cut to fit most windows, 3 x 6-ft. (\$18.95) and 6 x 6-ft. (\$27.95). For further details, contact Solar Components Corp., Box 237, Manchester, N.H. 03105.

(Please turn to page 130)

"HOW TO BE A GREAT ENERGY SAVER" SALE!

EAR MUFFS (to keep out the cold as well as the screams over high fuel bills)

THAT CONFIDENT LOOK YOU GET FROM SHOPPING AT SERVISTAR.

HUSBAND'S WOOL SWEATER

(on top of own wool sweater, on top of flannel shirt, on top of long Johns, on top of goose bumps)

DAP ACRYLIC LATEX CAULK

Interior and exterior use. Reduces heat loss. White. 10.3 oz. Reg. Price \$2.99

SALE PRICE \$1.47
#11465

BATTERY OPERATED SOCKS (to conserve energy)

GE SILICONE II CAULK
Seals, weatherproofs and insulates. Clear. 10.3 oz. Reg. Price \$6.99

SALE PRICE \$3.97
less mfr's. rebate* **\$1.50**

YOU PAY \$2.47
*rebate effective only from 9/1-11/30
#GE5000

SERVISTAR DUCT TAPE

Seals heat in. Gray. 2" x 10 yds. Reg. Price \$1.75

SALE PRICE \$1.33
#SSR-100

WARP'S SHRINK-IT™ WINDOW SEALER KIT

Clear plastic. Shrinks tight with hair dryer. 38" x 64". Reg. Price \$2.99

SALE PRICE \$1.97
#SK38

BREATH (not bad, but highly visible due to thermostat set at 60°)

GOLDEN 52" CEILING FAN

Circulates warm air. 3-speed reversible. Wood blades and brass accents. Brown or white. Reg. Price \$79.95

SALE PRICE \$64.97
#329

SAVER SPECIAL! SERVISTAR FURNACE FILTERS

Help cut heating costs.
16 x 25 x 1 16 x 20 x 1
20 x 25 x 1 20 x 20 x 1
Reg. Price .99

SALE PRICE .57

CHOPPER 1 SPLITTING AXE

Splits firewood faster and easier. 36" Fibre-core handle. Reg. Price \$36.95

SALE PRICE \$27.97
#CHI-36F

KNEES (knocking)

FILM-GUARD® PLASTIC SHEETING

Seals drafts out. Clear. 10' x 25'. Reg. Price \$6.99

SALE PRICE \$4.69
#MH72B

WHEDON STANDARD SAVERSOWER

Saves water and energy year round. Chrome plated brass. Reg. Price \$8.95

SALE PRICE \$5.93
#SS1C

JOHN BUXTON

See your Yellow Pages for the dealer nearest you.

Sale Ends September 30.

SERVISTAR

Hardware ★ Lumber ★ Home Centers

83 HOME ENERGY GUIDE

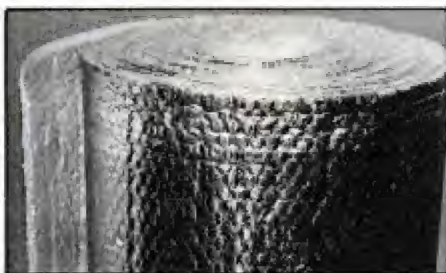
(Continued from page 128)



Nor-guard aluminum casement windows are claimed to be 30 percent more efficient than wood casements. The new design prevents heat loss and wind penetration with double or triple glazing. Available in white or bronze, Nor-guard casements range from 18 x 24 in. (\$115.50) to 33 x 48 in. (\$177.30). Triple-glazing prices are slightly higher. They're manufactured by Noranda Building Products Co., 7120 Krick Rd., Walton Hills, Ohio 44146.



This cutaway of a Weather Shield quad-pane window reveals two layers of 3M's SunGain film suspended between sealed glass. According to the manufacturer, the clear, ultraviolet-protected film admits 96 percent of the sun's energy and keeps interior heat from escaping. Windows with SunGain film cost approximately \$2 to \$3.25 more per sq. ft. than single-glazing windows. For more information, you should write to Industrial and Consumer Sector/3M, New Products, 3M Center, St. Paul, Minn. 55144.



Foil-Ray reflective insulation is made from plastic bubble sheets (the kind used for protective packaging) laminated on both sides with aluminum foil. The maker claims the 1/4-in.-thick insulation has an R-value as high as 14.89. Foil-Ray can be used by itself or with other insulating materials. A 300-sq.-ft. roll (4 x 75 ft.) costs \$124. Foil-Ray is manufactured by Energy Saver Imports Inc., 8611 West 71 Circle, Arvada, Colo. 80004.



Sky-Vue now offers flat skylights in large sizes. Units range from 22 1/4 x 22 1/4-in. to 46 1/4 x 46 1/4-in. in both fixed and ventilating models. They're priced from \$254 to \$784. Every Sky-Vue unit is equipped with a twin-layer acrylic skylight that provides an insulating dead air space. For more information about these units, contact Skylights, APC Corp., Box 515, 50 Utter Ave., Hawthorne, N.J. 07507.



Apply adhesive-backed Gila advanced energy film to window interiors and prevent summer heat buildup and winter heat loss. The film is available in clear, bronze and gray in 35-in. x 48, 78 and 96-in. sheets. Prices range from \$23.88 to \$88.55. For more information, contact Gila River Products, 6615 West Boston St., Chandler, Ariz. 85224.



United States Stove Co., Box 5349, Chattanooga, Tenn. 37406, introduces the Legacy Wonderwood (\$559) and the Wondercoal (\$597) thermostat-controlled stoves. The Wonderwood (above), with a 24-in. log capacity, burns wood only. The Wondercoal can accommodate coal and wood. Both of the models feature lift-up tops, auxiliary cooking surfaces and fire-brick linings. A two-speed electric blower is optional on both units.



Honeywell introduces the W964 Aquatrol solid-state boiler reset system (\$470), shown with two temperature sensors and a space temperature compensator (in hand). The Aquatrol system senses both outdoor air temperature and discharge water temperature. As the outdoor temperature changes, it resets the boiler water. Most boilers heat water to a constant temperature regardless of the outside temperature. According to Honeywell, the Aquatrol system can reduce energy bills by as much as 20 percent. For details, contact Inquiries Supervisor, Honeywell Inc., Honeywell Plaza, MN12-4118RE28, Minneapolis, Minn. 55408.

(Please turn to page 132)



HOT NEWS.

AMANA BRINGS YOU THE ONLY GAS FURNACE OF ITS SIZE TO CUT HEATING BILLS BY NEARLY ONE-THIRD.*

You'd never guess it. But today the typical gas furnace—new or old—loses so much heat through exhaust, it gives you only 62¢ worth of heat for every dollar you spend.**

Not very impressive when you consider the current call for economical heating.

So consider the Amana Energy Command™ Gas Furnace, with two features that make it the hottest new achievement in home heating.

Heating costs go down as fuel efficiency goes up to 95%. That's because along with its exclusive Heat Transfer Module (HTM®), the Energy Command recovers heat from the exhaust and recycles it to make it 95% fuel efficient.*** Fact is, it's the only forced air

gas furnace of the popular 80,000/100,000 BTUH size that gives you 95¢ of heat for every dollar spent.

And, because the Energy Command has a special venting system, you can get this sort of efficiency installed easily—even without a chimney.

But efficient home heating isn't all our gas furnace gives you.

Amana's hot option: the only furnace that heats water faster. Plus, only the Amana Energy Command has an optional hot water tank—one that'll provide 2 to 2½ times more hot water than conventional 40-gallon water heaters.

Now that's impressive. And you can keep on being impressed. Just contact

your nearest Amana Heating and Cooling dealer for details, or write Amana Refrigeration, Inc., Dept. 961, Amana, Iowa 52204.

The Amana Energy Command Gas Furnace. Because today people want money to spend. Not to burn.

*Compared to a typical 62% fuel-efficient furnace. Heat-cost savings with Amana Energy Command Furnace may vary depending on efficiency of your furnace, fuel cost, climate, and other home heating variables. See Amana dealer for details.

**Based on Department of Energy and Gas Research Institute Information.

***Annual Fuel Utilization Efficiency as determined by Department of Energy Standards.



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■ King (74" x 80")	■ 59.95 (#604)	■ 69.95 (#609)

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145-81

83 HOME ENERGY GUIDE

(Continued from page 130)



The Steel King Model 480 is a forced-air furnace that burns solid fuels. It can be used as an independent heating system or as an add-on to conventional gas, oil and electric furnaces. The Model 480 is available in three models. The 480-R (\$889) is for burning wood only, the 480-S (\$957) burns wood and coal and the 480-RC (\$1,084) is an efficient wood burner fitted with a catalytic converter. For further information, you should contact Steel King Inc., Solid Fuel Div., 325 East Beckert Rd., New London, Wis. 54961.



Radiators are making a comeback, but today's models are electric, portable and oil-filled. Shown here is the Welbilt Model RW900T (\$119). Its nine fins produce up to 5,600 B.T.U.s. A built-in timer turns the heat on and off at your convenience. Additional features of this Welbilt unit include an on/off safety light, a recessed handle and electric cord storage. For details and further information, contact Welbilt Corp., Box 7804, Welbilt Square, Maspeth, N.Y. 11378.

PM

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SHARP ENOUGH

After 4 yrs. of splitting wood for 3 fireplaces, my maul is still sharp and cutting enough cut wood to give me wood for a week in a half hour of splitting.

Jerry Blinzley, Hubbard, OH

YOUNG AT HEART

I received the Monster Maul I ordered last week and my husband was very pleased with it. He says it's "fantastic." At the age of 61, he split a pile of wood as if he was twenty. Enclosed is a check for \$24.96 to order one for my son-in-law. You certainly should be commended for a product as good as you advertise. I've never been that lucky before.

Mrs. Carl Maskham, Warwick, RI

HUSBAND EATS CROW!

Ordered your maul for husband for Christmas. Read how woman lost 15 lbs. using it. Decided to try just to make sure it worked (never read directions on how to use). The weather was damp after much rain. Stood up a block of wood about 8" in diameter, hauled back, hit'er with a whack. Nothing! Tried 4 or more times. Darn glad I could get my money back. Went to check how to return the "Thing" and by chance read how not to use the maul. So had husband read the instructions. His reaction. Did you fall for that? That thing isn't any account at all! You can tell by looking at it that it is worthless! How much did you pay for it? On and on until it was more than I could stand. He finally felt sorry for me and said, "Oh well I'll try it since it's here." It worked - He ate crow. Scratches his head and says, "Don't know how that silly looking thing can work but it does." So maul has place of honor along with #1 chain saw. Instructions have a place with the Bible and everyone is happy and warm with fast results when the wood pile runs low of wood. Thank you so much.

Marcella Poland, Dundas, IL

A GREAT FEATURE

Yesterday my "Mighty Maul" arrived and the U.P.S. driver said, "This looks like it could cause a lot of hard work but it must be pretty good because I've delivered quite a few already this year." "It must be pretty good" is an understatement. "Great" is a better word. As soon as it was delivered I had it at my wood pile trying it out. The forked logs I left from last year's splitting efforts were split with no problem using the Mighty Maul. The Mighty Maul split right around the large knotted logs and one of the greatest features about it is that it won't stick in the wood like other mauls & axes. I never would have believed that the "Mighty Maul" with its very simple design would be so effective, but after working with it, I am now a firm believer. Thank you for a great product and please feel free to use any part of this letter as a testimonial.

Larry Eveler, Kansas City, MO

THE MONSTER SWING

I have now used the Monster Maul on red maple. I quartered a 16" dia., 24" long piece in 5 swings. As I recall, that job would have lasted about 1/2 hr. or more with my 2 wedges and a sledge.

George J. Korinek, Willow Springs, IL

THUNDERBIRDS

(Continued from page 64)

candidates—Bostick, for instance—had never flown the F-16.

"They took me out and put me in the rear seat and said, 'It's yours,'" Bostick recalls. "It was quite a jolt. But, of course, an airplane is an airplane. One jet isn't much different from another."

By October 1982 the Air Force team was in place—four formation pilots, two soloists and two backup crew members. They performed in their first show over Nellis AFB before an audience that included hundreds of fighter pilots sitting in bleachers in the Nevada desert. The April show crammed 30 maneuvers into a half-hour program, including the best known and most difficult—the Trail-to-Diamond Roll.

This routine is one in which the pilots really appreciate the raw power and sheer maneuverability of the F-16. They enter the maneuver at 300 feet, the four jets flying stepwise, each one just a few feet above the next.

When Latham calls "nose up," the four craft pull up sharply into a 3 G soar. At the order "rolling left," the formation, still rising and now at about 2,000 feet, makes a 25° roll to the left. Now the F-16s are on about the same level. The leader maintains the lead,

while the No. 2 craft moves to the left and No. 3 craft goes to the right. No. 4 then fills in the slot so that the planes form a diamond. To get into the middle in time, No. 4 has to exceed the 400 knots of the other craft by upward of 50 percent.

When he's in the slot, he notifies the others by saying "four is in." The lead responds with the order "into float." The diamond is then turned upside down as the four planes roll in unison at 2,500 feet. They slow to just over 200 knots, until the leader calls out, "back in with pull." Now the four jets right themselves, dive down toward the earth at 20° off the horizon, with the gravity forces dwindling until near-weightlessness at just about 300 feet.

At the order "power up, smoke off, ready, now," the team makes a left turn past the crowd at 300 feet and sets into position for the next trick.

"Since we were flying a frontline fighter, we wanted to pick maneuvers representative of combat aircraft," Latham says. Even at the start of things, the Thunderbirds show their prowess by jumping off the runway at a 60° upward angle, something no T-38 could ever hope to do.

The F-16s fly through the sound barrier at above 35,000 feet. But the jets run well beneath maximum speed at

the low altitudes called for in air shows. The unused speed is a key to the safety of the new team's equipment.

"We're more in the center of the performance envelope, both in terms of powerplant and airframe, rather than on the edge, as in the old T-38s," says Lt. Col. Mike Wallace, a spokesman for Nellis. Thus, the jets are able to run at speeds too slow for most other craft to remain aloft and too fast for most other craft to attain.

Most impressive to the men who fly the Thunderbirds is the visibility from the cockpit. Perched in a bubble canopy with a customized seat, the pilot has a 360° field of view. In a show, it means never losing your wingman. In combat, it could mean never losing your life to an enemy sneaking up behind you.

The head-up display on the cockpit's windscreen lets the pilot see 20 miles ahead without taking his eyes off the instruments. "An on-board computer and the redundancy of the control systems covers the possibility of error," Latham says with great confidence.

There are some situations too hot even for the F-16s to handle. When they were flying T-38s, the Thunderbirds had no worries about heat from a nearby craft damaging their plane in flight. Now, with the large amount of compos-

(Please turn to page 136)

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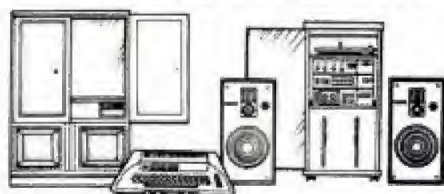
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THUNDERBIRDS

(Continued from page 134)

ite materials in the new craft, pilots have to be more careful about keeping their distance.

In rehearsal, the Thunderbirds shoot for precision to the inch. "Being a fraction of a second late is the subject for a debriefing," Bostick says. Before a performance at a strange field, the team pores over aerial reconnaissance photos no more than six months old. The pilots familiarize themselves with landmarks at which each maneuver will begin. The base line is 12,000 feet of runway, 6,000 on either side of the reviewing stand. On exhibition day, team members fly up and down the area in a light plane or helicopter, making sure that trees and bushes are where they were shown in the recon photos.

On their comeback day, the Thunderbirds were cheered with thunderous applause from fellow pilots and civilian spectators alike. The crowds thrilled as the jets with their black Thunderbird emblems screamed overhead. It was so exciting that even a warmup show with the Army's Golden Knights precision parachute team seemed to pale.

"We don't think of it as a comeback," Latham noted. "It's a fresh start that we worked very hard to achieve." **PM**

ROWING SHELLS

(Continued from page 67)

at close to 15 mph, the single-scull record is just under 11 mph.

A rowing shell essentially fools water into believing it hasn't been disturbed. Its high aspect (length to beam) ratio and fine (sharp) ends take the craft out of the usual situation in which a boat must either apply great amounts of power to *plane*—virtually climb up on and ride its own bow wave—or remain forever trapped by the theoretical speed limit (1.4 times the square root of the waterline length to give nautical miles per hour) of the wave system it creates. Having a very low range of available (human) power, the rowing shell's first obligation is "don't make waves."

This isn't as simple as it sounds. The shell also needs enough beam so that a rower doesn't spend all his energy just trying to stay in balance. Remember, in addition, that any rowboat is unique among vessels in two ways: First, the main "cargo" constantly shifts fore and aft. And with a rowing shell's sliding seat, that shift covers a surprising percentage of total boat length. Second, its speed is *never* constant; it is either accelerating or decelerating.

Contrary to casual observation, nee-

dle sharpness is *not* the answer. Without buoyancy on its ends, a shell will mush down aft when the rower is "compressed" prior to stroking and plow down forward at the end of his stroke. "Actually, the ends have to be as full as possible," says shell designer Britton Chance, "but not to the point where they will cause wave-making, separation drag or excessive rough-water resistance." Chance's Warning (as in "Small Craft . . .") design is said to be among the potentially swiftest recreational rowing shells available. Small Craft Inc., the Norwich, Conn., firm that builds and markets the Warning, says the shell is as much as "a knot faster" than some competitors.

How and where a recreational shell will be used has a definite bearing on its design.

Arthur Martin, known even by his competitors as the father of recreational rowing, has been marketing his Alden Ocean Shell design for more than a decade as the optimum rowing machine for unsheltered—even offshore—waters. Competitors quibble about the basic shape of Martin's shell—one even claims it will go faster backwards—but there is no doubt that rough water performance calls for more fullness forward.

Art Javes, who years ago produced

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the popular Aqua-Cat sailboat, is the lone innovator in applying a twin-hulled format to recreational rowing. Two hulls may suggest an inordinate amount of wetted surface, a drag component, but Javes insists it doesn't work out that way. "We might give a little away on that score to a fine racing shell," Javes says, "but not to the recreational designs. Besides, with two hulls—the rower suspended between—you don't have to expend any effort in maintaining stability."

Javes builds the 19-foot Row Cat, plus his latest, the Omni-Cat, offering a triple option: sail, oar or pedal power. Rigged with a double-pedal setup, Javes says it has hit 15 mph, which would make it the world's fastest pedal craft and put it in a league with eight-oared Olympic shells.

Most of the available recreational shells are made of hand-laid fiberglass. Some offer all-wood (usually cedar-strip) options which weigh an average of 15 to 20 pounds less. For a recreational rower, light weight is more important as an out-of-water handling factor than in performance.

The sliding-seat/outrigger assembly is a critical component which can add \$500 or more to the price of a shell. For efficiency and comfort, a rower's posterior (the seat) should be on a higher plane than his heels when his feet are in the restraints. In some shells, the rigging is integral; in others, a combined seat/footrest/outrigger assembly can be dropped in and removed easily.

The basic technique of rowing poses no problem for most people. Small Craft's Bill Fisher, who gives instruction with every shell, figures on a matter of minutes to teach the average woman basic stroking, but perhaps an hour or more for most men. "Men almost always try to overpower it," says Fisher, "as if more muscle is the answer to any problem. It's not—it's basically a matter of finesse."

Once the feel of a shell becomes comfortable, balancing—with those long oars (which are also buoyant, if wooden) as compensators—is second nature.

The new breed of recreational rowing shell offers great fun and exercise. One rower, in his 60s, claims his form improves every week—still. Another says: "When I get it moving right, and I'm into my rhythm, there's nothing I've ever done—on wheels, skis or in mid-air—that can match it." **FM**

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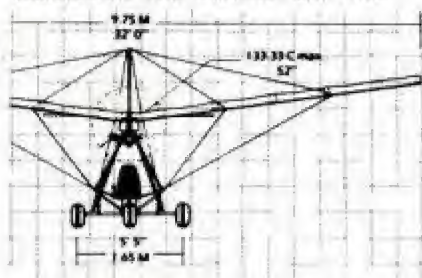
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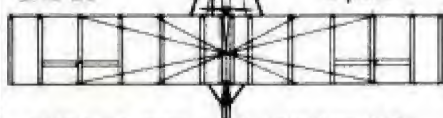
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THE WORLD UP CLOSE

(Continued from page 78)

line up the glasses with your eyes. Even if your iris is stopped down to 2 mm on a bright day, lining it up with the 7-mm exit pupil of a 7×50 is much easier than the 2.5 mm of a 6×16 mini. This is why the 7×50 is the standard Navy binocular. On a heaving deck, you need the leeway. This applies to any glass used from an unsteady platform or a moving vehicle. (You can see the size of a binocular's exit pupil by pointing it toward an available source of light—never the sun—and holding it at arm's length. The little circle of light in the center of each eyepiece lens is the exit pupil.)

Twilight factor gives you a numerical idea of how the binoculars work in dim light. To find the twilight factor, multiply the objective lens diameter by the magnification, 35×7 for a 7×35, for example, and take the square root of the result, in this case about 15.6.

As a rough guide, a twilight factor of less than 10 works really well only in

except if you're using them to catch fast motion.

Zoom binoculars combine most of the problems of wide-angle and super-wide-angle binoculars with internally moving lenses. Finding a pair with acceptable quality—one that doesn't go into and out of focus as you zoom—can be difficult. Keeping it working can be an even greater problem. A better way of combining high and low magnification may be to carry a pair of 6×30 binoculars and a 20× spotting scope or monocular.

Interpupillary distance adjusts by folding or unfolding the binocular on a hinge to match the distance between the barrels with the distance between your eyes. Having the numbers marked on a scale makes it easier to reset the distance when a pair is passed from one person to another, if you memorize your eye spacing.

Single-hinge binocs are much easier to adjust than those with two hinges, which help them fold up super-small. Double-hinge models don't have an interpupillary scale, so they must be reset by trial and error every time you use them.

Finding the right pair

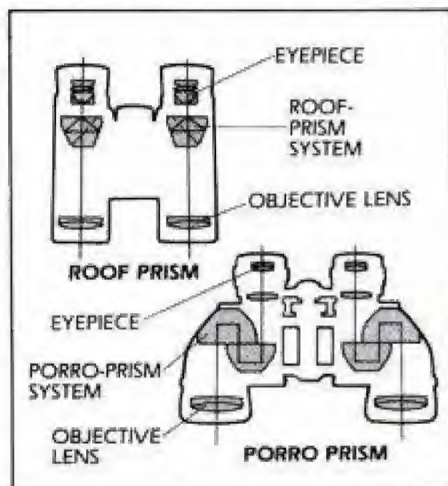
Armed with this information, you are ready to go into the store to shop. Once you've decided on the size and type you want, collect as many different makes and models of it as the store has to offer. All your possible choices should have nearly identical magnification. But you might include armored and bare models, porro and roof prisms, and close but not necessarily identical objective lens sizes—7×30 and 7×35, for example.

Adjust the eye spacing to suit you and fold down or remove the eyecups if you wear glasses. If possible, pin up a newspaper in a good light about 30 feet away. (In some stores, you can use signs in other departments.)

Compare two pairs at once, holding one on top of the other, and looking first through one and then the other. Compare contrast, brightness and sharpness—which headlines can you read easily? Switch quickly from one to the other. Keep the one you like best and make the same test with a third pair, and the fourth or fifth.

Check the lenses for visible scratches, smudges, clouded areas and antireflective coatings. By pointing each lens toward a light (not the sun) or white surface and looking into its objective lens, you can see into the binoculars. Dust, metal chips and blobs of glue indicate poor workmanship. Metal

(Please turn to page 140)



Prisms bend the light rays, thereby allowing binoculars to be shorter than they could be without prisms.

bright daylight; 10-12.3 in general daylight; 12.3-14.1 in dark shade; 14.1-17.3 at dusk or dawn; 17.3-20 in bright moonlight; and 20-plus at night.

The field of view

Field of view may be given in yards, meters or degrees, at a rate of 1,000 yards or meters away from the viewer. To compare binoculars labeled in different systems, multiply the number of degrees by 17.5, which is the number of yards or meters in 1 degree at 1,000 yards or meters. To compare in feet, multiply the number of degrees by 52.5. As a rule, the higher the magnification, the narrower the field.

Wide-angle binoculars are designed to extend the normal field. Eyeglass wearers may have difficulty using wide-angle models because they can't see the full field. Super-wide-angle binoculars are rarely very satisfactory,

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THE WORLD UP CLOSE

(Continued from page 138)

clamps securing the prisms are a good sign. Each lens should be a purple or violet color if properly coated. One that looks white is uncoated. If the literature with a binocular says it has coated lenses but does not say that *all* air-to-glass surfaces are coated, it means some are not. Uncoated surfaces cause flare, reflections, reduced light transmission and can be particularly annoying for eyeglass wearers. Find another pair.

Checking alignment

Check alignment by focusing on a straight line, like a telephone wire or the eaves of a building. Move the binoculars away from your eyes and see if the line is still straight. Swing the hinge through its arc and see if the line remains straight. Any detectable alignment problem makes this pair of glasses unacceptable. Try another pair by the same maker; they will probably be aligned correctly.

Price matters. Really cheap glasses may mean that low-grade materials (optics, prisms) are used. Shortcuts may have been taken in assembly and alignment—forcing your eyes to adjust to the glasses. This may result in dis-

comfort during extended use if they lose alignment from handling and use over a period of time.

Price surprise

More expensive glasses may not really be as costly as you might think. First, a good pair of binoculars is a long-term investment, so you can charge off the cost over 5 or 10 years of use, making even a \$100 price difference relatively insignificant. Second, if the binoculars don't work well for you, you won't use them very often, which could make a less expensive model cost more than a better glass that becomes a constant and satisfying companion.

You may also be pleasantly surprised to find that a pair you like is relatively inexpensive.

The first big jumps in quality often come in the first few steps up from the bottom of the price scale. Good daylight performance is available at very moderate prices. Really good glasses for dim light are larger, heavier and usually more costly.

Whichever binoculars you select, if you pick them carefully for your requirements and then make a point of taking them with you and using them, you, too, can start seeing a whole new close-up world.

SOURCES—BINOCULARS

Aimpoint, USA Inc., 201 Elden St. Suite 103, Herndon, Va. 22070.
Apollo Optics—Senns Corp., 505 3rd Ave., Spokane, Wash. 99202.
Brunton Co., 620 East Monroe, Rifton, N.Y. 82501.
Bushnell Div., Bausch & Lomb, 2828 East Foothill Blvd., Pasadena, Calif. 91107.
Compass Industries Inc., 104 East 25th St., N.Y. 10010.
Edmund Scientific Co., 101 East Gloucester Pike, Barrington, N.J. 08007.
Jason/Empire Inc., 9200 Cody, Overland Park, Kan. 66214.
E. Leitz, Rockleigh, N.J. 07647.
Leupold & Stevenson Inc., Box 688, Beaverton, Ore. 97075.
Minolta Corp., E.J. Howard Co. Inc., 850 Third Ave., New York, N.Y. 10022.
Montgomery Ward, 619 West Chicago Ave., Chicago, Ill. 60607.
Nikon, Inc., 623 Stewart Ave., Garden City, N.Y. 11530.
Novatron, Box 531, Big Bear City, Calif. 92314.
J.C. Penney Co. Inc., 1301 Avenue of the Americas, New York, N.Y. 10019.
Pentax Corp., 35 Inverness Dr. E., Englewood, Colo. 80112.
Sears, Roebuck and Co., Sears Tower, Chicago, Ill. 60684.
Steiner—Pioneer & Co., 216 Haddon Ave., Westmont, N.J. 08108.
Swarovski America Ltd., 1 Kenney Dr., Cranston, R.I. 02920.
Swift Instruments Inc., 952 Dorchester Ave., Boston, Mass. 02125.
Tasco Sales Inc., 7600 Northwest 26th St., Miami, Fla. 33122.
Traq Inc., 8601B Northeast Underground Dr., Kansas City, Mo. 64161.
United Binocular Co., United Bldg., 9043 South Western Ave., Chicago, Ill. 60620.
Weatherby Inc., 2871 Firestone Bldg., South Gate, Calif. 90280.
Carl Zeiss Inc., 1 Zeiss Dr., Thornwood, N.Y. 10594.

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30 DAYS WITH HERO-1

(Continued from page 74)

can be programmed with a device called a teaching pendant.

The teaching pendant is by far the easiest method. It plugs into Hero's base on a long cord and is a well-labeled remote control. Every function of Hero's movements—forward and reverse in three speeds, swiveling his head, moving his optional arm and the attached wrist and closing his two-pronged hand—can be controlled by the operator. And, when he's in the Learn Mode, Hero will remember what actions you've put him through and will be able to repeat them over and over.

The Learn Mode and the pendant are fine to get started. But true roboticists will quickly move on to robot language and begin to dabble in assembly. This step is necessary to go beyond movement, to take advantage of Hero's built-in senses.

Hero's sound and motion sensors are hidden behind a perforated panel on his left temple. His two tubular eyes are really sonar rangefinders. And then there's the optional voice module in his chest. To make all these things work, you should have a good understanding of what makes Hero run, walk, talk, see and remember.

Once you become adept at programming (and Heath's optional Robotics course at an additional \$100 is highly recommended), you'll be amazed at all of the things you can accomplish. Perhaps the first thing most Hero owners will experiment with is his voice.

Hero's first words

There are a number of built-in phrases which Hero can quickly be programmed to say. These range from "People stare at me because I'm short" to "Emergency!" But it's even more fun to teach Hero to speak from scratch. You can break down every spoken word into verbal building blocks called phonemes. Then it's just a matter of telling (programming) Hero which phonemes to speak and which ones to accent heavier than the others.

The hobbyist will then move on to helping Hero take a few steps—or, rather, a few spins of his wheels. Following that, Hero's arm can become an interesting experiment on its own. The complexity of pivoting the arm while keeping in mind the position of the wrist, the attitude of the rotatable grippers and the relation of all that to the robot's swiveling head is very challenging.

Hero is such a lively little fellow that you'll wonder where he gets all his

energy. Plugged into the wall, he'll go on longer than you can keep up with him. Or, running on three rechargeable batteries in his base and one in his head, he's good for a few hours. For longer battery operation, you can program him to sleep overnight, waking up every 10 minutes or so to do a programmed task.

What you program Hero to do is more a function of your own imagination than anything else. He's a very capable robot, although he's certainly no weight-lifter (don't figure on having him lift more than a pound).

In our own home, late at night, Hero is on patrol. First he goes into the living room, swivels his head and checks for motion. Then he rolls into the kitchen, the hallway and other rooms. Finally, if he detects an intruder, he'll shout at his loudest volume, "Help! Help! Don't hurt me!" Hero, you see, is too young to carry a weapon.

Like all children, Hero is a bit on the expensive side. Priced as a kit complete with both arm and voice, he lists in Heathkit's latest catalog at just under \$1,500. Without the arm and voice, he's a nickel under \$1,000. Or, the stork will drop him off fully assembled with arm and voice for about \$2,500.

But then again, who can put a price on family? **PM**

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MUSIC BOX

(Continued from page 86)

groove the sides for receiving the cabinet back. Also dado the cabinet back for accepting all shelves. Shape both edges of each side with a 1/2-in. rounding-over bit.

Before assembling the cabinet, notch the front-corner details on all shelves—except the bottom shelf—as shown. To cut the notches, first bore a 1/2-in.-dia. hole located 3/4 in. in from the shelf front and side edges. Then, use either a band saw or sabre saw to remove the waste. Shape the front edges of all shelves (except the bottom shelf) with a 1/2-in. rounding-over bit.

Checking the joints

Dry-assemble the cabinet to make certain all joints fit properly. Start final assembly by gluing the cabinet shelves and back into the side dados. Then, clamp the cabinet square. Counterbore 3/8-in.-dia. × 3/8-in.-deep holes at all screw hole locations on both sides. Bore 1/8-in.-dia. pilot holes and screw the cabinet together with 1 1/4-in. No. 8 fh screws.

Next, make the rounded cove details used at the cabinet's top rear and bottom front. Form each cove by edge-gluing together three 2 1/2 × 21-in. oak

boards. Cut the joining edges with the saw blade set at a 22 1/2° angle. Then, glue and clamp the cove pieces into the plywood jig as shown. Notice that a clamping block is used to provide even clamping pressure.

After the glue has dried, round the outside cove surface, using first a bench plane and then sandpaper. Now, cut the cove length to equal the cabinet interior dimension. Secure each cove with four 1 1/4-in. No. 8 fh screws. Conceal the screwheads by plugging all counterbores with 3/8-in.-dia. walnut plugs.

Assembling the storage drawer

Next, make the tape cassette storage drawer. Notice that the drawer front is notched at each end to match the shelf detail. To make the drawer, first lay out the dovetail joints used to join the drawer sides with the drawer front. Mark the 5° sloped dovetails onto the side pieces. Then, cut along the sloped lines using a dovetail saw or a fine-tooth backsaw. Next, use a coping saw to rough-cut out the waste in the joint sockets. Trim the sockets clean with a sharp 1/4-in. chisel. Use the finished drawer side to mark the dovetail pins onto the mating drawer front end. Be sure to keep all edges aligned. Then, rout out the waste area from the drawer

front joint using a 1/4-in. straight bit. Finish trimming the sockets clean with a sharp 1/4-in. chisel.

Now, cut the rabbets into the drawer sides for accepting the drawer back. Then, groove all drawer pieces for installing the 1/4-in. oak veneer plywood drawer bottom. Assemble the drawer with glue and clamp it square. Once the glue has dried, belt sand all surfaces and shape the drawer front's edges with a 1/2-in. rounding-over bit. The finished drawer fits snugly between the second and third shelves and operates without using slide hardware. Apply paste wax to the drawer bottom edges occasionally to ensure smooth operation.

Building the cabinet base

Now, build the cabinet base. Cut the base members as shown and assemble them with glue. To install the base, first counterbore 3/8-in.-dia. × 1-in.-deep holes into the base stretchers. Then, use four 1 1/2-in. No. 8 rh screws to secure the base to the underside of the cabinet bottom shelf.

After finish-sanding the cabinet, apply several hand-rubbed coats of Watco Danish oil finish. Allow the oil to dry, then apply a protective paste wax coat. Install and wire up your stereo components. Now, sit back and enjoy. **PM**

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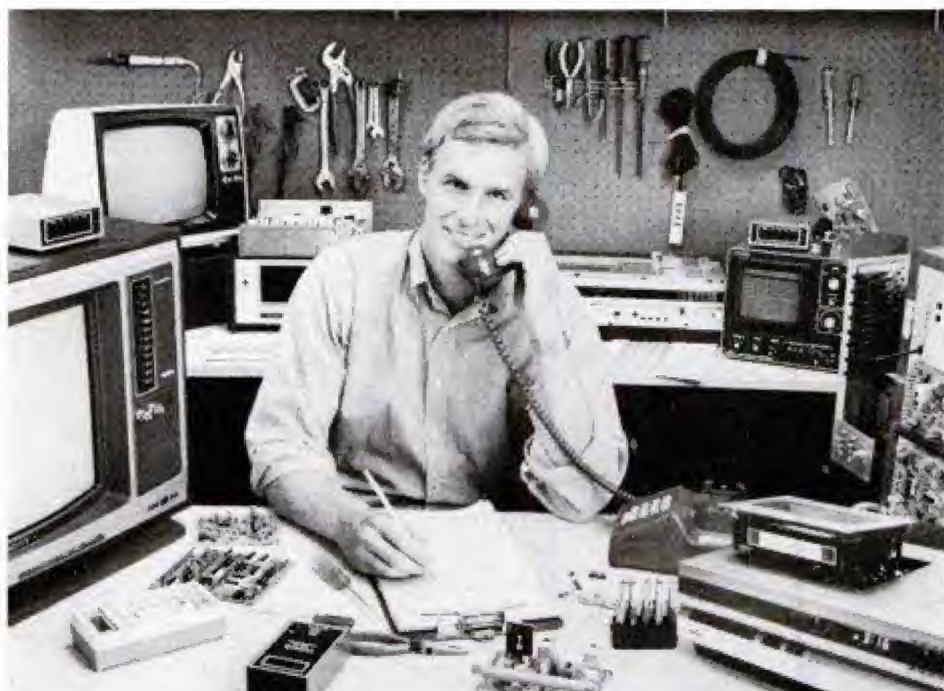
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UNDERWATER CAMERAS

(Continued from page 73)

me a chance to try the three cameras in and out of the water. The equipment performed beautifully, but a week of stronger than normal winds churned up the normally clear waters off Key Largo. Pictures taken under such conditions or on overcast days lack contrast and vivid color. Midday is the best time for underwater photography because less light is reflected off the water.

The light that enters the water quickly picks up a bluish cast due to the water's ability to absorb the red end of the color spectrum. In shallow depths, a CC30 R filter can be used to restore some of the warmth to your pictures. Nikon makes such a filter for its Nikonos and I'm sure a 3-in. gelatin filter could be stuffed into the Disc Camera's housing. The Hanimex could present a problem. Below 20 feet or so, only a

flash unit can restore the true colors.

All three cameras produced well-exposed pictures. I found that resetting the ASA speed of the Nikon was necessary to trick the camera into providing more light to the film when shooting back-lit or lightly colored scenes. On the Nikonos and the 35 Amphibian, you must set both the estimated distance and an f-stop that will yield you a high enough shutter speed to avoid getting back a bunch of blurry pictures.

Use slow-speed, fine-grained films in shallow depths. High-speed films are a must for taking available-light pictures at depths below 25 feet. In dark-bottomed lakes and rivers, use high-speed films all the time. Because of the different refractive qualities of water and air, images appear closer underwater than they do above water. This makes the angle of view of the camera's lens less wide underwater than above. To take wide-angle pictures, you need a very

short focal length lens. Nikon makes a 15mm which delivers a 94° angle of view. Underwater cameras used in salt water should be rinsed in fresh water after use. Their seals should be maintained and lubricated with silicon grease when necessary.

Knowing something about the ecology of the underwater environment will not only help you take better pictures, but makes awfully good sense. So does bringing along a buddy when you're diving. And with these cameras and housing, you can have years of underwater picture-taking pleasure. **PM**

MANUFACTURERS LIST

Hanimex 35 Amphibian (\$279.95) and Hanimex Wet 'N Dry Disc Camera Housing (\$20.95): Hanimex Inc., 1801 Touhy Ave., Elk Grove Village, Ill. 60007.

Nikonos IV-A with 35-mm. f2.5 lens (\$516): Nikon Inc., 623 Stewart Ave., Garden City, N.Y. 11530. Sunpak Marine 32 Electronic Flash (\$466): Sunpak Div., Berkey Marketing Co., 25-20 Brooklyn-Queens Expwy., Woodside, N.Y. 11377.

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TECHNOLOGY UPDATE

AVIATION

World's hottest homebuilt

For the first time in nearly four decades, this month's upcoming National Air Races at Reno, Nev., will be the proving ground for a homebuilt racing plane designed for nothing but pure, blazing speed. Since World War II, unlimited-class air racing has been dominated by souped-up military brutes like F8F Bearcats, P-51 Mustangs and F4U Corsairs. They were awesomely powerful, but ponderously heavy for turning pylons at 450 mph.

Now a slim, light, agile newcomer, called Tsunami after the Japanese name for tidal wave, will attempt to show its prop wash to the established competition. Packing a 2,400-hp Rolls-Royce Merlin V12 in its nose and a tiny cockpit way back near its tail, it's reminiscent of the sleek little backyard-built speedsters of the 1930s, the glory years of air racing. Virtually the entire plane is devoted to wringing maximum output from the powerplant without its blowing to bits. The center is taken up by three large tanks—one for fuel, one for cooling water to spray the radiators and one for a water-methanol mix for injection. An unusual dual radiator circulates oil and coolant simultaneously. In the event of a blown engine, jets will spray the canopy with solvent to wash away oil.

While the Tsunami is a homebuilt, it's far from an amateur undertaking. Developed by a team of Lockheed engineers, headed by Bruce Boland and John Sandberg of California, it represents the ultimate refinement in high-performance racing technology. Its gross weight of only 5,100 pounds is two-thirds that of a typical stripped-down war-surplus fighter. Its projected speed, flat out, is a blistering 520 mph, which, if achieved, could make it the fastest prop-driven plane since the Red Baron, a highly modified P-51, set the current record at 499 mph in 1979.

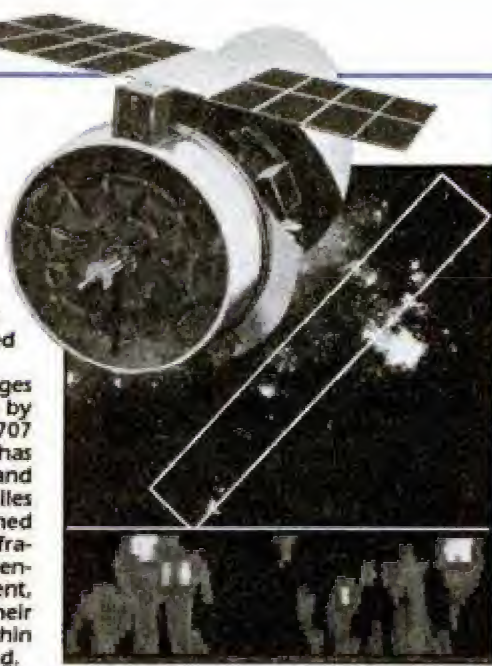


SPACE

BEETLE SEES STARS

Jet Propulsion Lab scientists call it the Beetle because its weight and shape are reminiscent of a Volkswagen. The Infra-Red Astronomical Satellite (IRAS), launched last February, might even be called a super Beetle. The IRAS telescope (right) has discovered more stars than all earthbound infrared scopes of the past 30 years.

The old scopes saw only faint images because most infrared light is blocked by the Earth's atmosphere. And NASA's 707 jet equipped with an infrared scope has been limited by its need for refueling and maintenance. But from its perch 560 miles above Earth, the IRAS scope has returned sharp images (lower right) even of infrared light coming from the Large Magellanic nebula. With computer enhancement, the images are giving astronomers their first glimpses of galaxies (shown within rectangle at right) forming in the cloud.



3-D WEATHER WATCHER

Is the global weather pattern changing? A satellite launched in April may soon give us some answers. The National Oceanic and Atmospheric Administration satellite (right) works with spacecraft from Japan and Europe as part of the World Weather Watch project. Two dish-shaped antennas, set at the base of a pole antenna that bounces radio signals off the Earth, produce a 3-D image in the satellite's computer. The computer then transmits a signal to the Earth, producing a 3-D global weather map.



MILITARY



New MLRS launcher fires 12 missiles a minute.



New tank-busting missiles lay down instant mine fields

You're a lone GI on patrol and you suddenly spot a column of enemy battle tanks rumbling toward your lines. What do you do? No sweat. You call for an MLRS, the U.S. Army's latest and most awesome piece of field artillery. Developed by Vought, the MLRS (for Multiple Launch Rocket System) is a fast, mobile missile launcher that can fire up to 12 projectiles in less than a minute, then speed away at 40 mph—called shoot-and-scoot in military lingo—before the enemy has time to detect it.

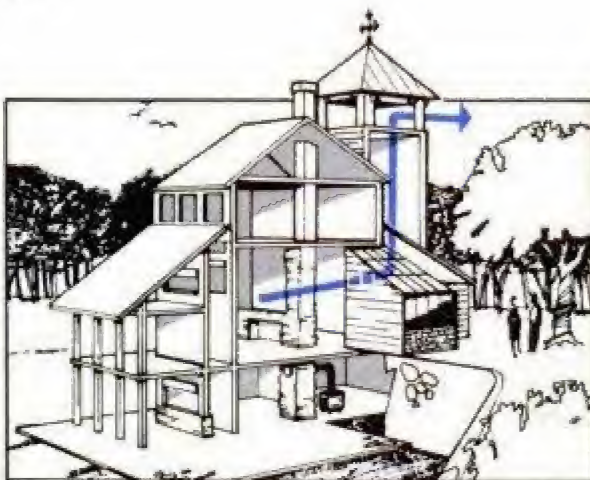
The rockets can be fitted with three different interchangeable warheads. In one mode, possibly the most ingenious yet devised, they can lay down an instant mine field in front of advancing tanks. Each projectile, at the height of its trajectory, releases 28 land mines attached to small parachutes—or a total of 336 mines in each 12-round burst.

The mines float to earth, automatically deploying a trip wire on top. Tiny legs on the bottom keep their shaped

SHELTER

Open house

University of Florida architect Ron Haase has designed a house he says will provide air-conditioned comfort with no moving parts. The same house, he says, will provide warmth in the winter through solar heating. The Haase house, winner of the American Solar Energy Society's 1982 design prize, is a one-room-deep cracker box affair. Its central observation tower has an uninsulated roof that superheats the tower, creating a constant breeze. Screen



Cool air drawn up central tower creates constant breeze.

porches surround the single-room center of the house.

In winter, the family retreats to the smaller inner spaces and the observation tower is closed off. A greenhouse supplies all the heat.



TENT FOR HELICOPTERS

Anyone who's ever set up a large tent will cringe at the thought of the Army's experimental helicopter tent. But it's actually easier to erect than a general-purpose large tent. Developed at the Natick Research and Development Labs in Massachusetts, the tent can be carried and erected by a team of eight men. The 84-foot-long, 26-foot-wide, 20-foot-high enclosure stands on bags that are inflated with a portable pump. It'll see first use in training exercises next winter.

Editor: Dennis Eskow

Contributors: Sheldon M. Gallager; Jack Hammond;

Frank Lusk; David M. Stewart; Susie Stevenson;

Robert L. Epstein, M.D.; Phyllis Wollman

Remote-controlled telescoping crane reloads MLRS automatically.



PM art: Dean Ellis

charges upright. As a tank rolls over a trip wire, the charge explodes under its thin belly armor.

In a second mode, the projectiles each disperse 644 grenadeliike, armor-piercing bomblets, or nearly 8,000 per 12-round salvo. In a third mode, still under development, the warheads deliver terminally guided antitank missiles, enabling the MLRS to track and hit targets while on the move.

While designed for a three-man crew—driver, gunner and commander—the MLRS is so highly computerized and

automated that it can actually be operated by a single GI in a battlefield emergency. It even reloads itself. An overhead crane extends out from the launcher, picks up fresh rocket pods and slides them back into firing position.

Eventually, all NATO nations will be equipped with one or more versions of the MLRS. Replacing an entire battery of conventional artillery, it's designed to counter Russian might in Europe without our resorting to nuclear weapons. Thus, its real significance lies in its potential as a peaceful deterrent.

INVENTIONS



JAM SESSION

The National Bureau of Standards' new Portable Magnetic Field meter (above) is a wand attached to a battery-operated set of detectors. The wand can trace any radio signal to its source or calculate the direction and strength of any radio, radar or microwave signal leaving a transmitter. It should be helpful in locating jamming devices and measuring changes in the Earth's magnetic pull.

Shot-glass spacemen

Plunk down \$2 on the bar at Diamond J's in Livonia, Mich., and you can climb into the Saker One and go for a ride in space. The 350-pound structural foam ball seats one. A 26-inch, 20-hp turbofan powered by a 60-amp. motor creates a 100 mph wind that lifts the enclosed ball about 3 feet off its pedestal. Sitting inside the ball, which opens at the top like a clamshell, you can shift your weight and move the central stick to perform different airborne maneuvers. A few inches below the middle of the sphere on each side are small plastic airfoils which control pitch, roll and yaw. By shifting your weight to a far side of the cabin and pulling in the stick, you can even turn upside down. Inventor John Sassak is selling Saker One for \$2,500. The ride, incidentally, lasts five breathtaking minutes.



PM photo: David M. Stewart

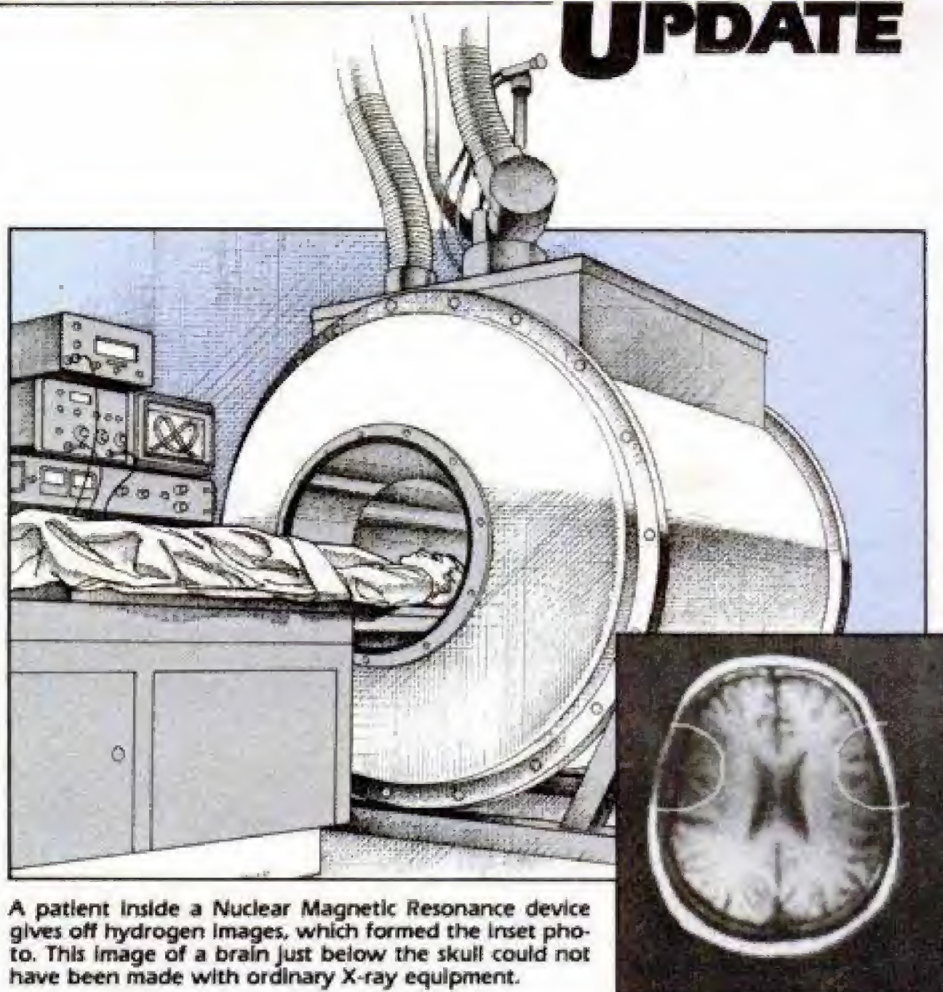
A rider sits in Saker One's structural foam ball that floats on a 100-mph blast of air.

MEDICINE

Getting into your skull

Although X-rays are very good at capturing fractures, they miss some kinds of tissue and can't find certain types of cancer in the early stages. But a new technique, called Nuclear Magnetic Resonance (NMR), is giving doctors their best views ever inside hard-to-see parts of the body, such as the brain. NMR uses a doughnut-shaped electromagnet. The technique works because tissue other than skin, bones and blood contains large amounts of hydrogen.

The patient lies on a stretcher inside the magnetic field. Once exposed to the field, the hydrogen atoms spin like tops. After a few seconds, a high-energy pulse of light changes the positions of the hydrogen atoms. As the light subsides, the atoms realign themselves. This is picked up by sensors connected to a computer, which produces a picture. General Electric, a major producer of NMR machines, says the technique is being used in a growing number of hospitals for research and treatment of exotic illnesses.



A patient inside a Nuclear Magnetic Resonance device gives off hydrogen images, which formed the inset photo. This image of a brain just below the skull could not have been made with ordinary X-ray equipment.

A visionary shave

Nearsighted people have to wear glasses or contact lenses to correct their eyesight. But a new type of surgery called radial keratotomy is making normal sight possible without corrective lenses. Introduced in Russia in the 1970s, the operation involves making a very slight shave from the cornea, the eye's very tough outer membrane. Doc-

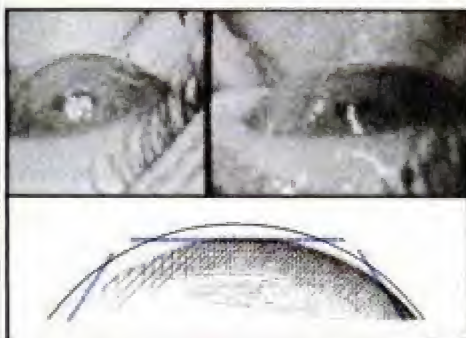
tors operate on one eye, wait eight weeks and then operate on the other eye.

Nearsighted patients usually have a misshapen cornea, which sharply focuses light from near objects but picks up only a blur at a distance. By flattening and steepening the cornea, the doctor creates a greater area of light reception, bringing distant objects into focus. The Federal Aviation Administration is so impressed it announced that patients who receive it successfully will be licensed to fly without glasses.



BIOLOGICAL CLOCK

It looks like a faceless pocket watch, but the eight microchips inside the Programable Implantable Medication System do something more important than tell time. The device, invented by Johns Hopkins physicist Robert E. Fischell, controls a tiny infusion pump that can be implanted in a diabetic's belly. It automatically dispenses a daily dose of insulin. To change the dosage, the patient calls the doctor and puts the telephone against the device. A signal from a small microprocessor changes the dosage. The device will have a profound impact on approximately 1.3 million Americans who need daily insulin injections.



Operation to correct nearsighted vision (left) changes the shape of the eye to let it receive more light. The repaired eye (far right) was shaped as shown in the diagram.

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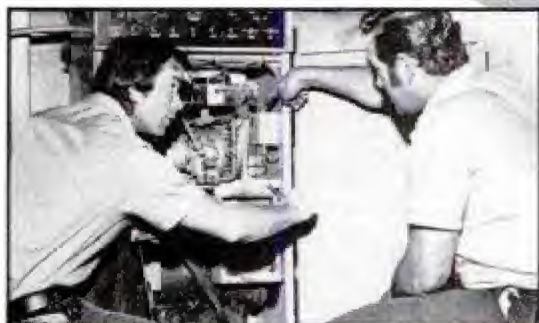
MICROCOMPUTERS The NTS/Heath HN89A computer is included in three programs. The experience you gain in assembling these kits is invaluable in the development of computer trouble-shooting skills. With home-computer sales expected to reach close to six million units in 1983, and perhaps ten million in 1984 the field for service and repair is rapidly expanding. The NTS/Heath HN89A has floppy disc drive, 48K memory on board, CRT terminal with its own Z80 processor, and Numerical Input Keyboard. Choice of CP/M or HDOS operating system.



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DETROIT '84

(Continued from page 71)

swirl-port combustion chambers, Pontiac's veteran 2.5 puts out a willing 92 hp. In base, nonair-conditioned, 2.42:1 top gear four-speed form, EPA mileage figures are an impressive 31 mpg city, 50 highway. The higher-performance 3.32:1 top gear four-speed SE version delivers 26 city, 42 highway. The 3.81:1 SE automatic numbers will be about 26 and 40.

Pontiac says the economy leader Fiero does 0 to 60 in 12.5 seconds, the SE with four-speed in 11.5 and the SE

automatic in 12.7. In our short early-test exposure on public roads, with Pontiac chief engineer Jay Wetzel in the passenger seat, the four-speed SE with two aboard felt slower than that. The automatic car, in fact, seemed subjectively more peppy due to its torque multiplication off the line.

The low-rev-range engine complains audibly above 4,000 rpm and runs out of breath at 4,500—hardly sports car territory. The wide-ratio transaxles do nothing for Fiero's FTDQ (fun-to-drive quotient), either.

There's more excitement on the horizon, though. Remember that the car's

proper name is Fiero 2M4 for two-passenger, mid-engine, four-cylinder. Watch for next year's 2M6. On-road handling was fine, especially with the optional WS6 performance package, which includes stiffer struts and springs and big Goodyear Eagle GT tires on alloy wheels. The car tracks and responds very well, with more than enough G-force capability for pleasingly fast but sane motoring. Our only gripe here is slow steering—19:1 vs., for example, the Trans Am Firebird's much more sports-car-like 12.5:1. With no power steering available (it was not deemed necessary due to the Fiero's low front-end weight), the high ratio is there to help keep the effort down.

Pushed hard on hairpin turns, the front tires give up first and plow to the outside. We'd prefer less dramatic understeer at the limit. But at least there's no tendency for the rear to get out of line. Rough-road ride is never harsh, but just choppy enough to remind you that it is a sports car.

Comfortable inside

Getting in and out also reminds you that it's a sports car. But once inside, enthusiasts of any age and almost any size will find themselves supported comfortably in excellent bolstered bucket seats with ample room in all dimensions and soft sheepskin seat inserts. A marvelous top-line stereo has speakers in the headrests.

Some luggage space for soft, flexible items is available up front between the radiator and the firewall. A deep well behind the engine compartment holds several shopping bags or a couple of golf bags. There's room behind the passenger seat for one small suitcase without losing too much legroom. And a decklid luggage rack is optional.

Bottom line: Fiero has deficiencies. It also has thoroughbred credentials—fully independent suspension, four-wheel power disc brakes, exotic mid-ship engine placement. All signs at the plant point to outstanding quality, and at well under \$10,000 (the exact price won't be known until just before the introduction this month), it offers a lot of value and FTDQ for the money.

It's not yet the ultimate sports car, but it's one hell of a sexy commuter.

Ford Motor Co.

Ford President Don Petersen went back to school last fall—driving school. He took the four-day competition course at Bob Bondurant's School of High Performance Driving at Sears Point Raceway near Sonoma, Calif.

Bondurant's trainers have long been Datsun sedans and sports cars. But Petersen wasn't about to use any "fur-rin" cars for his classroom, so he had

(Please turn to page 158)

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(Continued from page 156)

his SVO racing engineers whip up a hot 5.0-liter HO V8 Mustang and ship it out to Sears for him. The special Mustang performed well, and so did the Ford president.

He did it, he says, to learn to better evaluate the handling and other driver-oriented characteristics of his company's cars. And it was done without fanfare, without wishing to attract attention. He also says he had a wonderful time and learned a lot about how serious drivers use their cars.

Several things have happened as a result: Bondurant now has an exclusive contract with Ford, uses nothing but Ford products (mostly HO Mustangs) and reports back on how they perform, what wears out and how soon. No proving-ground test can duplicate the flogging inflicted every day at Bondurant's, so the inevitable result is better, tougher cars. And Petersen is sending groups of his key executives and engineers through the same course so they, too, can get The Religion.

Benefits to those who buy such cars already are showing up in '84 Ford products. More attention is being paid

to seats and seating position, steering, controls, instruments, shifter feel, even pedals. Pedals? That's right. Petersen has decreed that all Ford performance cars with manual transmissions will have their pedals arranged so that serious drivers can "toe-heel," or pivot their right foot over to blip the gas to "match revs" on downshifts while braking.

But what does this mean to the vast majority of normal, everyday drivers who could care less about toe-heel downshifting? A lot, because such unusual attention to detail carries over into all aspects of auto design.

Thus, for example, Ford's fwd subcompact Escort, Mercury's corresponding Lynx and the sporty, two-seat Ford EXP (Mercury's LN-7 counterpart is dropped for '84) have nicely redesigned interiors, more tastefully executed and function oriented, with a higher-quality look and feel. There's a turbocharged, fuel-injected version of Ford's 1.6-liter Escort engine available in EXP and (mid-year) Escort GT and Lynx RS, plus a new supereconomy 2.0-liter diesel for Escort/Lynx.

More horses

There's electronic fuel injection and more horsepower (200!) for HO Mustangs and Capris, plus a much-improved "quadra-shock" performance suspension and (for the first time) optional automatic transmission. Mercury's Cougar gets the T-Bird Turbo Coupe's injected 2.3-liter turbo engine, and it, too, can now be ordered with automatic transmission, as well as the standard five-speed.

Also on the power train front are fuel injection and a 15 percent boost in power and torque for Ford's 3.8-liter V6. The four-door Lincoln Continental is facelifted front and rear to match its new Mark VII stablemate and inherits the aerodynamic '84 Mark's air-spring suspension and new optional 2.4-liter BMW turbodiesel engine. Then there's the limited-production SVO Mustang with its intercooled 2.3-liter turbo engine, aerodynamic nose, "bi-plane" rear spoiler, and tires and suspension specially developed to go head-to-head with Chevy's new Corvette.

Due to a staggered '84 introduction schedule, we'll have more detailed reviews of all that in the next issue. But we've driven the marvelous new Mark VII and the EXP Turbo, and we can tell about those here and now.

It should come as no surprise that the Mark VII looks like the company's Continental Concept 90 and Concept 100 luxury show cars of the past couple of years. The styling follows Ford's rounded aero theme, with (newly legal) glassed-over headlamps and (nicely integrated) Continental trademark grille



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and rear deck. The new Mark is 13 inches shorter, 1.5 inches lower, 350 pounds lighter and 25 percent more aerodynamically efficient than the shoe-box-shaped Mark VI it replaces, and with a 0.38 coefficient of drag is the slipperiest luxury car built in America.

Under the slick new body is what Ford calls electronically controlled air suspension (EAS), which uses newly developed Goodyear air springs for constant three-way leveling, load compensation and an unusually smooth and quiet ride. Unlike the average softly sprung American luxury car, it feels highly composed and competent in the turns and on rough surfaces, thanks largely to standard front and rear stabilizer bars and gas-filled front MacPherson struts and rear springs. Also standard are power rack-and-pinion steering, P215/70R15 HR radial tires on 15x5.5-inch, cast-aluminum wheels and power-assisted, four-wheel disc brakes.

Standard power train is Ford's EEC-IV computer-controlled, fuel-injected 5.0-liter V8 driving through a four-speed overdrive automatic transmission and a 3.08:1 rear axle ratio. The high-tech BMW turbodiesel Six, complete with its own German-built ZF four-speed overdrive automatic, becomes available mid-year.

Five people fit inside, four of them very comfortably—the fifth has to straddle the traditional rear-wheel-drive hump in back. The instrument panel is fully digital and includes a multifunction trip computer with an input keyboard and two-color display: blue for information, green for warnings. Power window and mirror controls are on the center console, power doorlock and seat switches on the door. The latter is a direct copy of an innovative Mercedes design, a seat-shaped control that moves the seat the same way it is moved.

Neat storage box

Between the seats is a clever three-layer storage box: twin cup holders on gimbals (so your coffee doesn't spill in corners) on top; a slotted, removable cassette tray in the middle; and a roomy bin with a sectioned coin holder underneath. On an overhead console are dual-intensity map and reading lights, warning lights and another innovation: an optional compass and outside temperature readout with a built-in ice warning. Rear-seat passengers are treated to semi-bucket seating, integral headrests, center armrest, courtesy and reading lamps and a heating/cooling duct in the center console.

A new A-frame steering wheel on a tilt-adjustable column contains cruise control buttons and (for those who hate

Ford's recent stalk-control horns) a center horn button. Our only complaint is the windshield wiper/washer control stalk, which (as in most Ford products) is so far forward you have to reach for it. Ford interior designers apparently still don't understand what stalk controls are supposed to be for: fingertip operation *without* removing one's hands from the wheel.

Best news for luxury buyers who also consider themselves serious drivers (the same group BMW has been wooing for years) is the very impressive Mark VII LSC. LSC stands for Luxury Sports Coupe, and, believe me, this is no token effort. It has a serious handling suspension (bigger sway bars, stiffer spring and shock rates), quick-ratio (15:1) steering, a 3.27:1 rear axle for faster acceleration and high-performance Goodyear blackwall tires on special 15x6-inch cast alloy wheels. The tasteful interior is in leather, or cloth with leather inserts, and there's even plush carpeting in the trunk.

Performance and cornering

It was raining when we tested a prototype LSC at Ford's Dearborn Proving Ground, but we were amazed by its performance and cornering prowess nonetheless. Except for the smooth ride and very quiet interior, this new flagship could have been a sports car.

Traditional Lincoln buyers will be relieved to know, however, that there are also two designer Marks for '84: a two-tone gold Bill Blass edition and a monochromatic "Walnut Moondust" (brown?) version by Italian designer Gianni Versace. Both have wire chrome wheels and long lists of standard high-lux features.

Then there's the hot 1.6-liter turbo Four that debuts this fall in Ford's EXP two-seater. The numbers aren't final as this is written, but look for about 116 hp, 8.7-second 0-to-60 acceleration and 26 mpg city, 40 highway EPA ratings with the only transaxle it comes with, a five-speed manual.

Among the engine's features are an aluminum cylinder head with hemispherical combustion chambers, electronic port fuel injection controlled by Ford's EEC IV engine computer, compound-angle valves, overhead camshaft, forged aluminum pistons, forged steel connecting rods, a crankcase air/oil separator, a block-mounted oil cooler, and twin thermostatically controlled fans blowing through an aluminum radiator. The small, fast-reacting turbo-charger is driven by exhaust pulses from an internally split, or "bifurcated," exhaust manifold and blows pressurized air directly through a tuned aluminum intake manifold into the combustion chambers for minimum

(Please turn to page 160)



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DETROIT '84

(Continued from page 159)

turbo "lag" and excellent distribution.

The EXP comes with a special TR suspension (including Koni shocks) and wheels, P185/65R365 TRX tires, power steering and power brakes.

The front ride height has been lowered almost ¾ inch to bring down the half-shaft angles for reduced torque steer. Unfortunately, there's a turbo boost light instead of a gauge and no available oil pressure or ammeter gauges in the otherwise much-improved Escort/EXP instrument panel.

Equipped with this little engineering beauty, the EXP at least has some serious performance to go with its sporty looks and .34 drag coefficient. Put your foot down, pop the clutch and the front tires light up and pull the EXP to easy sub-nine-second 0-to-60s. Driving hard on the test track reveals almost no torque steer, but a lot of power-on understeer as the front tires struggle to develop cornering and acceleration traction at the same time. This is solved by modulating the throttle to get the back end out a bit and the nose pointing to the inside where you want it. This is one technique Petersen may have learned at Bondurant's.

Chrysler Corp.

Having returned to prosperity from near-bankruptcy in what seems like record time, peddling mostly sturdy, front-wheel-drive economy and family cars, America's third largest automaker is on a roll.

We saw the beginnings in '83: First the fine-handling Dodge 600 ES "Euro Sedan" and the delightfully quick and athletic Dodge Shelby Charger mini-performance coupe. Then early previews of the terrific '84 Chrysler Laser and Dodge Daytona 2+2 sports cars (*Firsthand Report: Dodge Daytona*, page 88, July '83) and the excellent Dodge Caravan and Plymouth Voyager fwd minivans (*The Garageable Van*, page 66, Aug. '83), which pioneer a whole new class of family/fun/utility vehicle. (The Voyager, incidentally, may have a different name when it reaches Chrysler-Plymouth showrooms later this fall. Debate continues as this is written.)

For the past couple of years, brash Chrysler executives have been talking about settling for nothing less than being "best in class." Now, with the biggest new-product launch in company history, they're starting to put out the hardware to back up that lofty goal.

Target vehicle for the base Laser/Daytona's handling, for example, was VW's lithe Scirocco. The L/D's optional performance suspension was aimed at

Porsche's 924. Independent tests record the handling-package L/D's at 0.85 G on a 400-foot diameter skidpad, just a hair behind the Camaro Z-28 and Porsche 944 (both 0.86) and ahead of everything else in the affordable sports car class. In a standard 1/4-mile slalom, the Daytona Turbo was quickest of all by a considerable margin. Chrysler's own proving-ground tests also give the L/D "best in class" in 60-to-0 mph braking (138 ft.), 0-60 acceleration (13.5-sec. with the standard 2.2-liter engine; 8.2 sec. with the 142-hp Turbo 2.2) and fuel economy (25/35 EPA city/highway for the base engine with automatic; 22/36 for the Turbo with five-speed manual).

More than competent

Driving these new Dodge and Chrysler sportsters at California's Laguna Seca Raceway and at Chrysler's Chelsea, Mich., Proving Ground quickly made a believer of me. The standard versions are competent enough, but the turbocharged L/Ds with the handling package are simply wonderful. They're fast and smooth, with almost no noticeable turbo lag, and they're easily the best handling fwd performance cars I've ever driven. They have virtually no torque steer and (unlike Ford's Turbo EXP) very little power-on understeer or tail-wagging trailing throttle oversteer. The steering is quick and precise and gives good feedback, and the high-tech chassis simply points the car where it's aimed, regardless of what you're doing with the throttle. Lee Iacocca may not have gone to high-performance driving school, but his suspension engineers seem to know what they're doing.

The roomy little vans are equally impressive, but in different ways. They drive like cars, and in high-level trim, like luxury cars. And, while Chrysler insists these are not just tall K-cars, they are K-derived and they do ride and handle much like the very nice E-Class sedans—which are essentially stretched and upgraded Ks. Their beauty is in their versatility: Whether you're hauling crockery, Cub Scouts or card partners, there's a seating and cargo room arrangement to fit. Chrysler wants to position the Caravan/Voyager (or whatever they ultimately call it) as a spacious wagon rather than a small van. Really, it's both. It feels on the road and fits into tight places like a mid-size car, but looks and works like a downsized van. However they choose to market it, it's America's first small, fuel efficient, garageable van, answering a need that's existed (I believe) for a decade. It's "best in class" by default at the moment.

No one company can realistically expect to be best in every class it com-

(Please turn to page 162)

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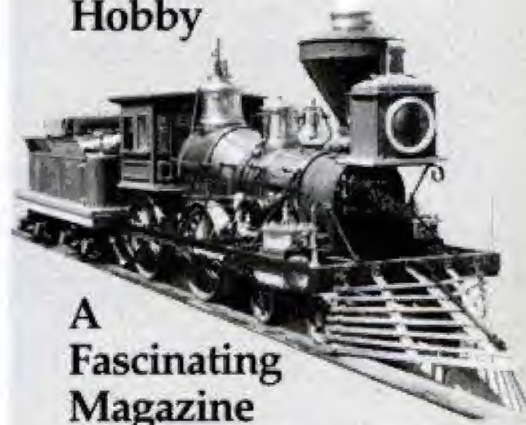
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DETROIT '84

(Continued from page 161)

petes in, but that doesn't keep Chrysler designers and engineers from trying. Like their crosstown rivals at Ford (and some enlightened souls at GM), they're looking and listening carefully, picking up good ideas from the competition and coming up with their share of original ones.

Chrysler's first fwd was tastefully retrimmed and got a thrifty new 1.6-liter Peugeot engine for '83. This year, the optional (carbureted) 2.2-liter Four is up 2 hp to 96, and the gutsy 110-hp 2.2 with five-speed transaxle (straight from the Shelby Charger) provides an exciting high-performance option. Power brakes, intermittent wipers and halogen headlamps are standard for '84, and a new instrument panel adds a voltage gauge and a larger, lockable glovebox. For enthusiasts on a budget, there's also a new optional cluster with full instrumentation, including tach.

This same "Rallye" cluster is standard in the O/H-based Charger and Turismo hatchback coupes, and the Shelby 2.2 engine and close-ratio five-speed are optional even in base models. These sporty little cars also get new quad-headlamp front ends (with a strong family resemblance to the L/D 2+2s), new taillamps, the Shelby's handsome rear pillar and quarter window design, new standard reclining bucket seats and (on the Shelby Charger and Charger/Turismo 2.2) a new liftgate spoiler. These high-spirited, budget street-fighters still need better seats and a lower, less awkward steering wheel position, but they give a lot of driving fun per dollar.

New grilles

In the compact-to-mid-sized segment, the very successful Plymouth Reliant and Dodge Aries K-cars get new grilles with a Chrysler Pentastar smack in the middle—the Reliant version looking very Mercedes-like—plus a larger (14-gallon) fuel tank and a new round-dialed instrument cluster with temperature and voltage gauges.

Chrysler's plusher LeBaron version, available in two-door, four-door, station wagon and convertible body styles, benefits from the same improvements and later in the year will offer the Laser/Daytona's port-injected, turbocharged 2.2-liter engine as an option. The Dodge 400, LeBaron's counterpart, is integrated into the upmarket 600 line, with the four-door sedan dropped and the two-door convertible redesignated as 600s, all with available turbo power.

We drove a LeBaron two-door with the turbomotor and found its suspension a bit too soft to cope with all that

performance, but the same engine in the more stiffly sprung Dodge 600 ES made for a dynamite, BMW-style luxotourer. Both Chrysler and Dodge convertibles are upgraded with more commodious rear seat room, glass rear windows, power rear quarter windows and other improvements. The luxury Chrysler E-Class sedan and fwd New Yorker also get new instruments, the larger fuel tank, the optional turbo engine and new wrap-around taillamps. The New Yorker comes standard with fully electronic instrumentation, including vacuum-fluorescent gauges for oil pressure, temperature, battery voltage and fuel level, plus a new "electronic navigator" trip computer.

The stretched-LeBaron executive sedan and limousine will be built in-house for increased capacity in '84, and the corporation's remaining rear-drive models—Plymouth Gran Fury, Dodge Diplomat and Chrysler New Yorker Fifth Avenue—are carried over for at least one more year due to demand.

Better Rampage

On the truck front, the little Dodge Rampage is facelifted and improved along with the Charger it's based on, while conventional Dodge pickups get upgraded brakes and a 360-cu.-in. V8 replacing the previously optional 318 V8. Power brakes become standard on full-size Dodge vans, and the Mitsubishi-built Power Ram 50 4wd mini-pickup now comes with automatic locking front hubs. Biggest news, of course, is the Mini Ram Van, Dodge's commercial version of the Caravan/Voyager, which boasts a 1,700-pound maximum payload, a cargo compartment that's 4 feet high from floor to ceiling and 4 feet wide between the wheelwells, and 25/39 mpg EPA ratings with its standard 2.2-liter engine and four-speed.

Then there's the '84 engineering story: more horsepower for the Mitsubishi 2.6-liter "silent shaft" optional engine, up from 93 to 101 hp in cars and 104 in the minivans; water cooling for the turbomotor's turbine center bearing to protect it from overheating after shutdown; magnetic conventional gauges in all fwd cars and advanced electronic clusters and trip computers in selected models; the Laser XE's 22-function graphic/vocal "Electronic Monitor" warning and information system, plus refinements to the regular 11-function "talking dashboard" to make it more helpful and less annoying; and mundane, but important, improvements to all '84 Chrysler cars, ranging from larger fuel tanks and steel-belted, all-season radial tires to an inch more front-seat travel for better legroom.

It looks like a good year, at last, for U.S. automakers in general—and an especially bright one for Chrysler. **PM**

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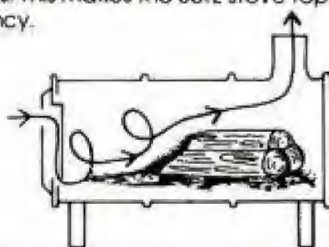
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Dennis H. Dwyer, East Orleans, MA

NO EXPENSIVE GADGETS

Super is the only word that describes your stove kit. I'm really impressed with the quality of the kit, heavy gauge steel and tight fitting flue collars, and door. The stove works super good, lots of heat and

a good long burn. I'm so impressed I've already sold my old stove. With the 55HD there is no need for expensive gadgets to capture heat that would be lost up the chimney. With a failing American economy we need more ideas like yours to put us back on our feet. Fewer imports, less big spending, better conservation and more ideas like yours will put us under-way. All right Sotz company!!!

Robert Marra, Bridgeport, NY
NO TROUBLE

I have been using one of your double drum stoves now for 2 1/2 years and I love it. I built 2 more for somebody else and your kit is magnificent. My gas bill for December and January was \$9.00 and \$11.00, and we are a family of five. This summer I am planning to move and you can count on it that I will take my stove with me or if the new owner wants it, I will make another one. I should have no trouble selling my stove to the new owner because I have saved all the gas receipts

and when you see, that the highest bill for 79-80 winter was about \$25.00, compared to my neighbor's gas bills of \$130.00 to \$180.00.

Angelo Callioni, Englewood, NJ

SNAP! CRACKLE! POP!

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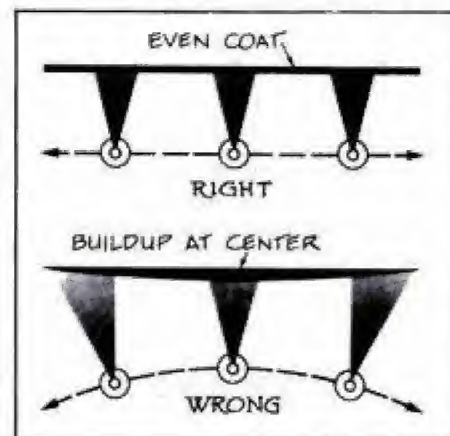
WORKSHOP MINICOURSE

(Continued from page 88)

are certain to provide you with consistently better results:

- Build up a number of coats rather than applying one thick coat
- Always spray with the can about 10 to 12 inches from the surface (see drawing No. 6) and remember to keep the can moving.
- As with other types of finishes, sand lightly between coats. But make certain the surface is absolutely dry before sanding.

PM



6 It's important that you hold the paint can nozzle the same distance from the surface being painted throughout each pass. Failure to do so will result in heavy paint buildup at the center.



7 After prime coat dries, sand, dust and wipe with tack cloth. Here, white enamel is applied over gray primer.



8 High-quality paint—properly applied—helped to provide this bread-box with a new lease on life.

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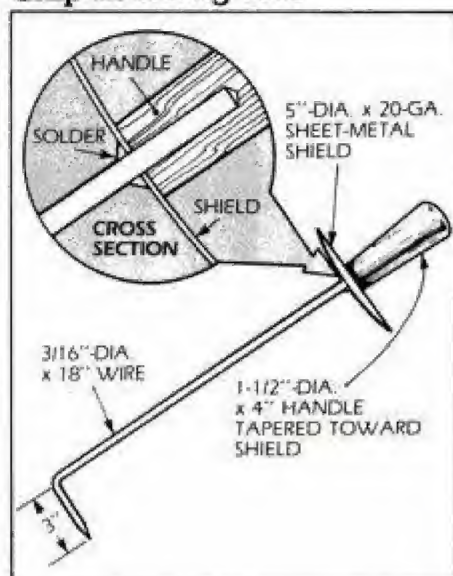
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HINTS FROM READERS

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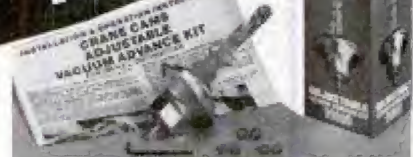
Every machinist, toolmaker and hobbyist who has worked with a metal lathe has had the irresistible urge to remove by hand the wiry, stringy coils and spirals that are formed by chips. He also knows the unpleasant consequences of responding to such impulses—deep cuts that are extremely painful and slow to heal. Next time, remove those chips with this handy tool made of 3/16-in.-dia. wire bent in a hook shape with a point ground on one end. Turn a wooden handle on a lathe and bore a hole centered on the other end. Insert the wire into the hole. Cut a shield of sheet metal and solder it to the wire.

—Frederico Strasser

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Up to 10 windows on one screen

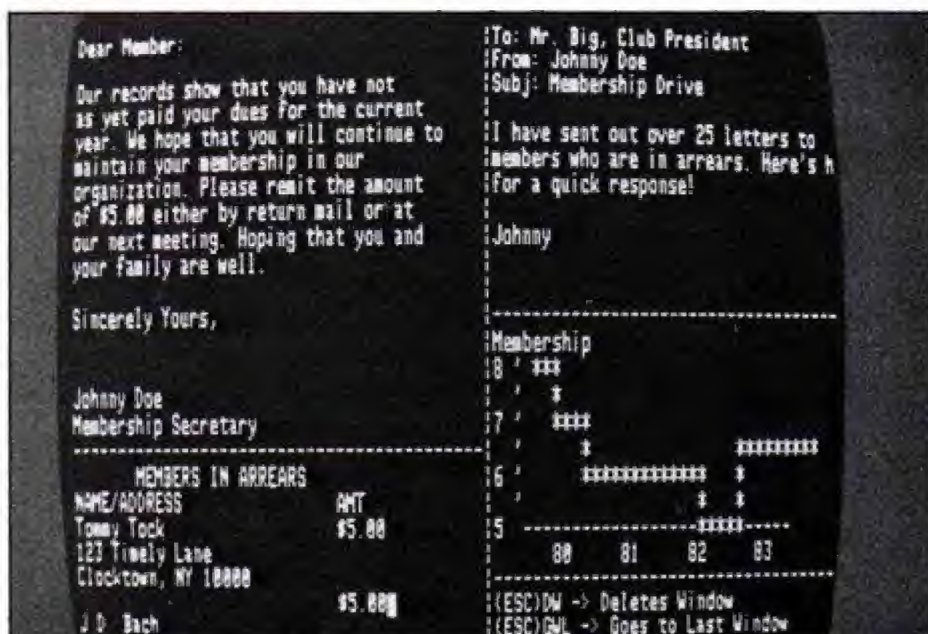
If you've ever tried to program a long, complex set of instructions, you know how annoying it can be to work on a monitor screen. The screen is just not big enough.

You can stare at one part of your program and then forget what a different part a hundred lines later may look like. Of course, you can print out the program, pencil in changes and corrections—then find yourself getting even more confused.

Or, you can buy *The Electronic Blackboard* program from Santa Cruz Software Services. It has many capabilities even beyond programming.

This versatile program splits your screen into as many as 10 "windows" or sections. Each window can be filled with text from its own file—or you can look at different areas of the same file in different windows. Text can be moved, changed, or searched through in each window independently of the others. Changes made in one window automatically update in other windows.

Besides programming, you can hook up this package to a word processor and really go to town. We show how a membership secretary might use this system (above). In one window is a letter the secretary is writing to delinquent members, while in the window underneath is a list of such members. In the upper right window he composes a letter to the club's president while, for inspiration, he keeps on-

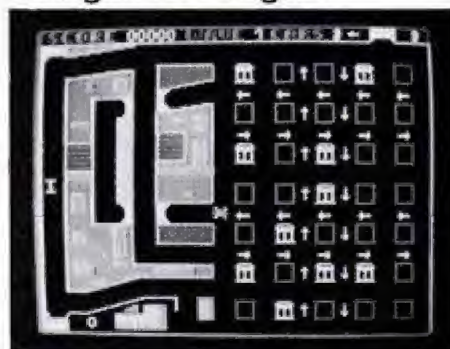


Above we show how *The Electronic Blackboard* divides screen into many windows.

screen a graph of the membership drive. And, in a small window he keeps track of a few command keys.

While *The Electronic Blackboard* does not have the printing and formatting features associated with word processors, it does save files to disk in a manner that most word processors can work with. So, you might use this in conjunction with a word processing package. It costs \$195 for almost all CP/M computers.—N.S.

The gallant Penguin



Crime Wave (above) is an amusing game for the Apple and Atari from Penguin.

They say it's a tough world out there in the software business. Pirates abound, ready to rip off your latest creation and make zillions of unauthorized copies. And, just to survive, you have to price your software as if it were on a golden disk. Well, don't believe it.

Penguin Software has been breaking all the rules and, so far, they've been delighted. First, they took copy protection off all the higher priced software. Then, they lowered the prices on games to \$19.95. According to the chief penguin, Mark Pelczarski, his firm is doing better than ever.—N.S.

AE



AE is Japanese for manta ray, and these mantas from outer space move in a most realistic fashion against high-resolution backgrounds. Disk is available from Broderbund Software for Atari and Apple.

Axis Assassin



A still picture can't do *Axis Assassin* justice. Its swirling and colorful aliens will enthrall every computerist. From a new company, Electronic Arts, it's available now for Apple and later for Atari.

chimney sweeps are cleaning up!

This may be the best start-on-a-shoestring business that we have ever featured! What other self-employment venture do you know of that you can get into for only \$2,500...yet which—right from the start!—can net you \$700 or more a week?



When chimney sweep "Mac" McLaurin of Gautier, Miss., isn't out making money with his August West System, he enjoys target practicing with his .357 magnum and serving his community as a volunteer fireman.



Mac's time is his own. Sweeping chimneys gives him plenty of freedom to hang out his "gone fishin'" sign. Why the top hat? "Good luck," he claims.

How would you like to own your own business, set your own hours, wear a top hat to work, become something of a mystical figure in your community, perform a necessary and much-needed service...and clear \$700 or more a week? Well, chimney sweeps all over the country are doing just that and the ones that we talked to love every minute of it.

Staffers J. Weiland and Travis Brock, for example, recently watched Steve Curtis clean chimneys in Connecticut for four hours...and pocket a whopping \$140 for his morning's work (Steve is averaging a gross of \$1,000 a week and he's booked ahead for a month and a half). Another sweep in Mississippi had already chalked up annual earnings of \$14,000 (\$3,000 during the first 21 days of that month alone) when Travis talked to him late in October. Yet a third sweep in Michigan, who told Brock he "just works at it part time," is taking home an easy \$300 to \$400 a week.

In fact, the *worst possible* case that Travis was able to track down was a guy who lived in a remote section of Montana (there are only 11,000 people in his whole county) who charged less than recommended rates for his services, only cleaned about 12 to 16 chimneys a month on a very, very part-time basis...and who *still* was netting (for less than one full day's work) a respectable \$100 a week. There just doesn't seem to be any way to fail in this business!

Chimney Sweeps, Of Course, Sweep Chimneys

Just what the heck do chimney sweeps do to earn that kind of money? They clean chimneys. Six to eight a day in the case of full-time sweeps...while part-timers generally average two or three an evening plus a few more on the weekends. When you figure that most of the sweeps charge \$40 for cleaning the first chimney on a job and \$30 more for each additional one, it's easy to see how those dollars can add up. (During the four hours that Weiland and Brock followed Steve Curtis around, for instance, Steve cleaned one chimney on one house and three on another...for a total billing—\$40 plus \$40 plus \$30 plus \$30—of \$140.)

But Why?

And why would anyone fork over forty or more bucks to have some character in a black suit and top hat clean his or her chimney? That question can be answered with one word: **SAFETY.**

When solid fuels such as coal and wood are burned in a furnace, stove, or fireplace they—as we all know—give off welcome amounts of heat. However—as many of us do not know—those same two solid fuels also give off unwelcome amounts of two by-

products: soot and creosote. And, unless a chimney is cleaned regularly, that highly flammable soot and creosote will accumulate in the flue. Where it hangs—like some fiendish fire bomb—just waiting for a chance spark to ignite it.

If the homeowner is lucky, the resulting roaring blaze will merely burn the chimney clean while filling the house with the fire's loud and extremely unnerving howls. If he's not so lucky, the unwanted fire will cremate the flue's lining and dangerously weaken the chimney. And if he's downright unfortunate, the flames will take out the whole chimney. . . and the rest of the house along with it.

All in all there were over 60,000 chimney fires in the United States last year and, according to the U.S. Fire Administration, those fires caused more than \$36 million worth of damage. That's a loss of \$36 million which could have been prevented if every owner of a coal- or wood-burning fireplace, furnace or stove had only understood the importance of keeping the unit's chimney clean.

The Plot Thickens

There was, of course, a time—back when nearly everyone on this continent heated his or her home with either a wood- or a coal-burner—when virtually everyone in North America was well aware of the havoc a chimney fire could wreak. Or, to put it another way, great-grandpa and great-grandma most certainly knew the value of keeping their chimneys clean. . . if they hadn't suffered one or more unexpected blazes themselves, they'd probably seen several neighbors and/or relatives burned out of house and home on a frigid winter's night.

But then history took a strange double-twist. First—beginning right after World War II—the United States and Canada made almost a complete switch in the way the two nations heated their homes. Within just 25 to 30 years, nearly the entire population of this continent dropped "dirty, troublesome" coal and wood. . . in favor of "clean, convenient" natural gas, oil, and electricity. And second—just when the major portion of North America's old coal- and wood-burning expertise had been forgotten—the "energy crisis" of the 70's suddenly forced a whole new generation, by the millions, to burn wood and coal once again.

Thanks to this quirk in our recent history, we now are surrounded by what must already be tens of millions of people who are at least supplementally heating their homes with solid fuel for the first time. And they are destined to be joined by further tens of millions of first-

time coal and wood users in the years ahead. And a heck of a percentage of all those folks [a] have absolutely no inkling of the time bombs that already are building up—and will continue to build up—in their chimneys and [b] have no immediate past generation with the proper firsthand experience to warn them about the ravages of flue fires.

Which Opens Up One Heck of An Opportunity. . .

We can draw at least three conclusions from this short history lesson:

[1] Since it now seems obvious that the "convenient" ways of heating a house—with natural gas, oil, and electricity—are going to continue getting more and more expensive as time goes on. . . it seems just as obvious that more and more families in the United States will continue making the switch back to heating with coal and wood in the years to come.

[2] Which means—whether they know it yet or not, and more and more people are discovering the fact every day—that an increasingly large percentage of this continent's population is destined to live with a steadily increasing risk of fires in their flues.

[3] Which just as surely means that anyone who can nip this growing danger in the bud is suddenly going to become very, very popular and is going to be very well rewarded starting now and continuing throughout the years ahead.

...For Chimney Sweeps!

And who is the most logical candidate to cash in on this burgeoning new demand? Who is the "anyone" most likely to become well rewarded for nipping the danger of flue fires in the bud? Why, a brand-new version of that fine old almost-mythical character of European folklore...the chimney sweep. That's who!

And that's also exactly *how* today's new breed of sweep is bursting upon the scene...as a black suited, top hatted, dancing-on-the-roof reincarnation of the character Dick Van Dyke played in the movie, *Mary Poppins*. Or, to put it another way, as a modern-day version of the traditional 19th century European chimney sweep.

Laugh at this showmanship if you like, but the sweeps who've tried it recently here in the U.S. and Canada have found that the legendary "top hat and tails" outfit of their trade has rocketed them to success overnight. As one of the new and very dedicated young men in the trade says:

"By re-creating the image of a 19th century

sweep, we accomplish several important things. [1] We grab people's attention, thereby making it easier for us to tell them about the dangers of chimney fires. [2] We grab the media's attention, and the newspaper stories and TV features which result . . . help us spread the word about the hazard of flue fires and just incidentally, makes our business grow by leaps and bounds. [3] Our image puts a little fun back into life. Stop and think. Who would you rather have clean your chimney: a 20th century serviceman wearing white overalls and a baseball cap...or a 19th century tradesman dressed up in top hat and tails? Hell, I've even had grown men go out of their way to shake my hand and pretty girls give me a kiss—just like something out of *Mary Poppins*—when they see my outfit. And [4] this simple little bit of imagery all adds up to a more lucrative operation for us. We attract people's attention, they feel good having us do a job for them, and—instead of begrudging us a reasonable fee for our services—they usually seem downright *happy* to pay for our work."

Good Sweeps Deliver The Goods

That same young man—and every other "new breed" chimney sweep worthy of the name—is also quick to point out that his "top hat and tails" image is just that. An image. Frosting on the cake. Gilding on the lily. A lot of fun as far as it goes...but nothing in any way that should be considered a substitute for doing an important and worthwhile job in a craftsmanlike and highly professional manner.

All good chimney sweeps do a good job of sweeping chimneys...and they do it *without* letting any of the crud get out into their clients' houses.

The Height of Technology

The most advanced method of sweeping chimneys—perhaps the most advanced in the world—is the one developed by Tom Risch of Westport, Connecticut. Tom calls it the "August West System" and—for \$1,785—will sell you a complete package of the tools you'll need to make it work. (And, yes, Risch's package *does* include a top hat.)

One of the key elements of the August West System is a highly specialized high-volume vacuum cleaner called a "Soot-Sweeper." Don't underestimate this piece of equipment. It is *not* merely a heavy-duty shop vac (which moves, maybe, 90 cubic feet of air a minute). This compact monster



Steve Curtis pulls in to clean a chimney with his August West System. His modified Ford van obviously has something to do with fireplaces...but the August West System—which can completely clean most flues from inside the house—doesn't give Steve much excuse to "dance on the rooftops" the way Dick Van Dyke did in the movie, *Mary Poppins*. Curtis just unloads his equipment—which includes a special sweeper and flexible fiberglass rods—takes it inside, and goes to work. As the photos above illustrate, chimney sweep Steve Curtis does almost all his flue cleaning "from the bottom" right through the fireplace.



Joel packs up his SootSweeper in his Honda CVCC - "I call it my Sootmobile," he says. "You should see people's eyes when they see me take my gear out of that car, or put it back in, it all fits too!"

moves 700 cubic feet of air per minute...which is about eight or ten times the capacity of your average house vacuum sweeper. But that's the kind of air-moving muscle you need if you really want to keep a cascade of soot out of your client's homes and out of your lungs. Nothing less will do.

A second key part of the August West Chimney Sweeping System is a set of specially developed fiberglass cleaning rods. These rods snap together with "quick disconnects" similar to the connectors on air-powered tools. And they're constructed of a mixture of fibers and resins and held to a diameter which makes them just flexible enough to bend around smoke shelves...but still rigid enough to poke a brush all the way up a chimney. The construction of the rods, furthermore, has been shrewdly calculated to make them tough and highly resistant to fractures. In the unlikely event of a break, however, the formulation of the rods' resin/fiber mixture and cure was designed to make the snap-together extensions splinter apart (like a green tree limb) rather than snap off clean (leaving a brush stuck in a flue somewhere). In short—just as with the August West SootSweeper—there's far more to the AW cleaning rods than meets the eye.

And there's far more to the August West profit picture than meets the eye too, thanks to the special gear just described. Because those rods and that SootSweeper make it possible, in most cases, for *ONE* man or woman (instead of two) to clean a flue or chimney entirely from the bottom (without ever getting up on the roof)...and do the whole job in a fast half hour (instead of the hour or hour and a half required by more traditional methods).

Steve Curtis—the personable young fellow whom Weiland and Brock watched, pocketed \$140 for four hours work one day last fall—uses the August West System.

First Steve spreads a painter's drop-cloth in front of the hearth, positions the end of his SootSweeper's inlet hose in the *back* of the fireplace, and turns the "dust sucker" on. He then reaches up into the fireplace's throat and removes the damper.

Next Curtis chooses the proper-sized brush, snaps it onto a Flexi-Rod®, and pushes the brush up into the flue. More rods are snapped onto the first one and fed up into the chimney until, finally, the brush pops out the top of the stack. Steve then scrubs the flue from the top down...while he remains conveniently and

safely indoors at the base of the chimney.

With every stroke of the brush, of course, a cascade of ashes and soot plummets into the fireplace. No problem. As fast as the black dust billows up...the SootSweeper sucks it away. Believe it or not, the system works so well that we couldn't even get a sequence of photographs showing how well this method of controlling an otherwise messy situation operates! There just wasn't anything to show!

Once the flue has been thoroughly cleaned, Curtis uses a smaller brush to spiff up the smoke chamber and smoke shelf. All the fine, airborne dust—as you've probably guessed—continues to disappear into the SootSweeper...while Steve shovels everything else into paper shopping bags. ("Don't use plastic garbage bags," Curtis says, "Because of their static electricity charges, soot sticks to the outside of the plastic sacks...and then falls off on your client's rug when you move them.")

If it sounds as if the August West System has chimney cleaning down to a science...well, it does. Using the AW streamlined method of swabbing out a flue, Steve Curtis can set up, clean a chimney, pack up, and be on his way to another job...all in 30 minutes or less. Which ain't a bad way to earn forty bucks.

The Other Side of The Business

If the pay can be good, it should also be pointed out that sweeping chimneys—even with the August West System—ain't exactly a desk job. Cleaning flues—no matter how you slice it—still calls for a certain amount of physical activity...and Steve Curtis honestly earns every nickel that he's paid.

Nor is this an occupation that you can work at carelessly. A sweep in Washington State, for instance, recently broke his shoulder when a new extension ladder malfunctioned and dumped him on the ground. Then too, slovenly flue cleaners soon learn that customers can get very irate about soot tracked across rugs.

In general, though, these risks of the trade are no risk at all to the careful and prudent chimney sweep. Just as the highly publicized "trade disease" of sweeps in the 1880's—skin cancer—presents no out-of-the-ordinary danger to anyone in the business who'll make regular use of soap and water.

(In the "old" days, sweeps used to climb right down into chimneys to clean them. Naturally, this coated them from head to toe with creosote and soot. The problem was then further compounded by the fact that most people bathed only infrequently in Europe in those days...and chimney sweeps sometimes didn't bathe at all! End result: a high incidence of skin cancer—especially cancer of the scrotum—among chimney sweeps. Which is unfortunate, since we now know that the disease could have been prevented by higher standards of hygiene.)

To Sum Up, Then...

Sweeping chimneys may not exactly be a "lazy man's way to riches"...but the pay is exceptional, the demand is steadily growing for this particular service once again, and new equipment now makes the job far easier and safer than ever before. Perhaps best of all, this most definitely is one of those "dream" businesses that so many of us are always looking for: a business with flexible hours and very low overhead that requires less initial investment (figure, at most, \$2,500 to get started with August West) than you can earn back in just three full weeks of work.

This may—all things considered—be the best start-on-a-shoestring enterprise that we have ever featured...and we're gonna be mighty surprised if a hundred or more readers of this magazine don't eventually wind up as \$1,000-a-week chimney sweeps. Be sure to let us know if you're one of the hundred!



additional information

August West Systems, Inc. 187 Kings Hwy. Cutoff - Dept. 83D8, Fairfield, CT 06430

The good folks at this company have probably done more to advance the art of sweeping chimneys than everyone else in the field put together since the business was first invented. For \$1,785 AW will sell you a complete system of all the specialized tools, operating instructions, and advertising and promotion ideas, etc., you'll need to start making important money immediately as a chimney sweep. You can order direct (don't forget your top hat size) or receive their free information kit by calling their Toll-Free number 800-243-5166. Ask for extension 838.

August West



Systems

Return Of The Beetle



South-of-the-border Beetle is driven by the author after being brought up to U.S. specs by company that buys them in Mexico.

The sound of an air-cooled Four is heard again—from Mexican-made Beetles.

BY MICHAEL LAMM
WEST COAST EDITOR

Déjà vu! Here I am tooling down the freeway in my old friend, the VW Beetle. Only it's not an old Beetle. For better or worse, it's a brand-new one.

I'm sure you've heard by now that at least two firms—the People's Car Co. of Solana Beach, Calif. and Sun Country Leasing/Sales of Mesa, Ariz.—are bringing new Bugs in from Mexico. They get them federalized so they're U.S.-legal, and then they sell them here. No, despite the rumors, you can't buy one for \$2,500. They cost, at this writing, \$6,995 and up. And no, they're not yet for sale in California. You can buy them in other states—or should be able to soon.

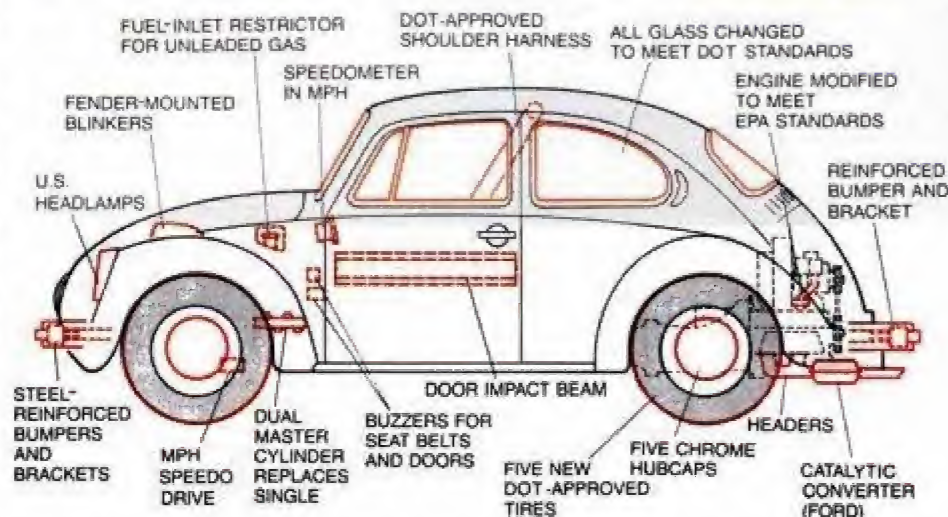
It might have crossed your mind to cut out the middle man and go straight to Mexico, buy a car from a Mexican VW dealer, and federalize it yourself. Well, some people have tried that. But

it's just too hard to get the Mexican Bug to comply with American DOT and EPA standards. So quite a few north-of-the-harbor folks who've imported south-of-the-border Volks have had their cars confiscated and lost all their money. Sad, but true.

Even with a host of bugs still to be ironed out, the People's Car Co. swears that its Mexican-assembled Beetles

pass not only federal EPA emissions standards, but also California's tougher smog code—and the U.S. Department of Transportation's safety specs. Our drawing points out what parts they change to make the Mexican Bug comply with American laws.

So, according to People's founders Lenny Macchiarella and Danny Najor, *(Please turn to page 174)*



Beetle from Mexico gets equipment shown here to bring it up to U.S. specifications.

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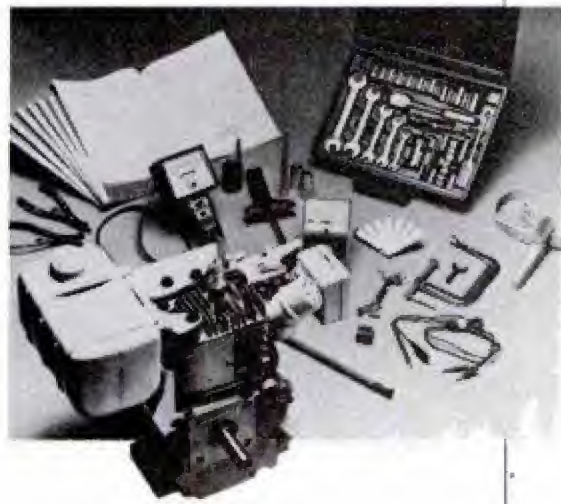
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RETURN OF THE BEETLE

(Continued from page 170)

it's not a question of "if," but rather "when" the Mexican VW invades North America in big numbers. Macchiarella had sold 39 cars at this writing, and talks about bringing in 500 cars during the rest of 1983, then 1,000-1,500 for '84, and 3,000 in 1985. People's Car Co. plans to sign up dealer/distributors in all 50 states plus Canada and the Virgin Islands.

For Canada, Macchiarella believes he can include all the necessary compliance items in a box, inside the car, so the new owner can install them. The Virgin Islands don't require emissions or safety changes at all.

Because the Mexican VW factory won't sell cars directly to People's Car Co., their cars are all previously registered examples that have been bought from VW dealers in Mexico. The speedometers are changed to mph models for the United States, but Macchiarella says they all have less than 1,000 miles on them.

I drove three different cars in the Solana Beach fleet. One was an unmodified car with full Mexican regalia. The other two had been federalized.

I don't feel that Mexican workmanship is anywhere near as good as it

used to be in Beetles from Wolfsburg. The details that used to place Bugs at such a high-quality level have eroded.

For example, on two of the cars I drove, the chrome headlight bezels were starting to rust. There's very little noise insulation. The rear suspension uses the pre-1968 swing axles instead of double-jointed halfshafts. You get cloth upholstery instead of leatherette. Seat firmness in the Beetles I drove varied considerably from car to car (although externally the seats looked identical). Decklids didn't shut tightly. And one decklid wouldn't open even though it wasn't locked.

In other words, you are getting what's outwardly a 1974-bodied Beetle, but it's not the one that made Volkswagen's reputation for quality.

How do they drive?

As for the way these cars drive—the federalized U.S. version and the straight Mexican Beetle felt identical to me. I don't believe any driver could tell which was which by any difference in acceleration, handling, braking, or sound. The 1,600-cc engine performs very well and willingly.

Part of that willingness comes from the lower final-drive ratio. The Mexican VW uses 4.375:1 differential gears, while the standard U.S. Bug had a

4.12:1 ratio (the Super Beetle ran with 3.89 gears). So at 60 mph, the engine revs higher than I'm used to, and it also makes more noise. I can't quote a top speed, but I'd say you're definitely pushing these cars at anything above a sustained 75 mph.

Steering feels positive and as quick as ever, and the car is just as susceptible to crosswinds as I remembered it. I was running in a 13-knot wind and could feel the blast every time I crossed a bridge or passed a semi.

Asked what he thought of the Solana Beach operation, VW of America vice-president Jim Fuller said, with some heat: "It stinks. What you get for your \$6,995 is a car that's at a late '60s level of development. For that price you could get a Wolfsburg special edition Rabbit." He also pointed out that VWoA will not honor warranty claims on imported Bugs.

All in all, I wouldn't pronounce the Chicano Bug a real glowing success. There's a lot of nostalgia here, I grant you, but if you're a dyed-in-the-wool Beetlemaniac, you might be disappointed in overall quality. Someone looking for an inexpensive set of new wheels—one that'll deliver good gas mileage at a low initial price—might be better off with a Corolla, Alliance, Colt, or, yes, even a Rabbit.

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MEMORY: RAM (RANDOM ACCESS MEMORY) BUILT-IN	32K	48K	64K
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*Manufacturers Suggested List Price as of April 1, 1983. CP/M is a registered trademark of Digital Research. Microsoft is a registered trademark of Microsoft Corp. Coleco is a trademark of Coleco Industries.

At the Winter National Consumer Electronics Show, Creative Computing Magazine evaluated personal computers at practically every price level. Among them all there was one computer they reviewed as "astonishing." The new Spectravideo SV-318. The personal computer that can meet the needs of everyone in your family. It outthinks, outperforms, outplays its competition...for under \$300. Compared to Atari 800 or Commodore 64, the SV-318 has more built-in Intelligence (ROM) to let you do more. Built-in super extended Microsoft® Basic language, the industry standard, makes it truly programmable. Built-in CP/M compatibility means access to over 3,000 of the most used business software programs. A built-in cursor control joystick makes editing easy and plays great arcade quality video games. (An optional adapter can plug you into the fabulous world of Coleco® games). Spectravideo also delivers a low-priced and complete line of peripheral accessories today. Unlike some of our competitors, whose peripherals are always "coming soon." It takes an outstanding computer to outclass our competition. At under \$300, nothing else even comes close. Today, discover the Spectravideo SV-318.

*April 1983

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OWNERS REPORT: T-BIRD

(Continued from page 79)

ing over to inspect my new Thunderbird. I've even had gas station attendants come out to check under my hood, and this was at the self-serve pump!"

The T-Bird's new size also influenced buyers' decisions. A self-employed Californian told us, "I really appreciate the new size. The Thunderbird feels like a big car but handles and maneuvers like a small one."

In the area of workmanship and general quality, the Thunderbird follows a trend. We've noticed, through these *Owners Reports*, a steady upgrading of quality in all U.S. automobiles. The quality gap between imports and domestic cars definitely has been closing during the past few years.

As evidence, 95.1 percent of our respondents rated T-Bird workmanship good to excellent. That alone stands as a solid endorsement of the car and puts its quality on a par with the Datsun 280-ZX and Celica Supra. Both are quality leaders, according to owners we've surveyed during the past two years. And the Thunderbird actually outscored many other imports.

Second, 72.2 percent of all Thunderbird owners reported that they'd had no mechanical problems of any sort.

Third, and perhaps most amazing, 44 percent had no complaints about their cars. These 44 percent found the Thunderbird perfectly suited to their needs and were wholly satisfied. That's another rare statistic nowadays.

A retired North Carolinian was one of 17.5 percent who'd owned a Thunderbird before. "This is my sixth Bird, and I feel I can safely say that the 1983 model is the best one—perhaps the best car—I've ever been in."

Perhaps the most convincing spokesman for Ford's quality revolution came from this New York bank collection manager. "I'd never bought a Ford product before," he said, "and would rather have walked than drive one. In my job of handling car repossessions for the bank, I noticed that the Ford cars that came back to us were usually tinier than most other makes, with more engine and transmission problems."

"But starting in 1982, I began to see a definite change, and when I first saw my Thunderbird on the showroom floor, I couldn't believe the interior luxury and the silence of the engine and ride. I bought the car immediately. Could it be that American automobiles are being built with pride and quality, finally? It seems that way now."

Front seating comfort won nearly universal praise, with 97.5 percent of our respondents rating it good to excellent. But the kicker came when rear-

seat riders also voiced nearly the same level of satisfaction: a 94.8 percent good/excellent tally. That's especially remarkable for a car of the T-Bird's size and type.

Traditional Thunderbird owners expect a smooth, luxurious ride, and that's what they get in the '83, but with a handling bonus. "I travel all types of roads in my T-Bird, and it seems to straighten out curves and bumps," said a California paper salesman.

The average driver appreciates the Thunderbird's marriage of good ride and agile handling. However, as one mechanical engineer from North Carolina pointed out, "The '83 Thunderbird is a comfortable, good-handling, good-cruising road car, but in standard form it's not the handler shown in the commercials. For that sort of handling, you need the TRX package." The TRX package includes heavier-spec suspension parts with special alloy wheels and Michelin 220/55R390 tires.

Two items came in for consistent criticism: 1) the placement of the optional full-sized spare tire and 2) the location of the horn "button." Taking the last first, it's not a button at all, but rather the driver has to push inward on the



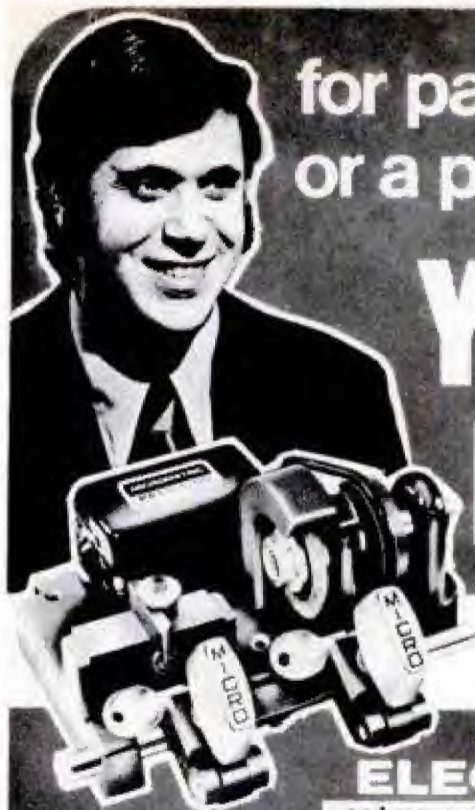
Five-liter V8 is one option. The other is 2.3-liter turbo Four. Our respondents have the 3.8-liter V6 with automatic.

end of the turn-signal lever. You'd think Ford would have gotten the message by now, because owners have complained about this system since 1978.

A New York interior designer said: "I can't emphasize how dangerous the horn location is. I nearly killed a young boy who chased a ball out onto the street. I simply couldn't find the horn and wasn't able to warn the boy to look out for me. If I had hit and injured him, I would surely have sued Ford."

The other problem, cramped trunk space, was mentioned by 13.7 percent of the owners we surveyed. The normal mini-spare wasn't the culprit, but when people ordered the optional full-sized spare, there's no place to store it except in the middle of the trunk floor. In that position, there's not much room even for grocery bags.

Virtually no one, though, complained about fuel mileage—a rare omission
(Please turn to page 178)



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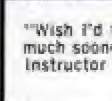
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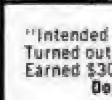
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OWNERS REPORT: T-BIRD

(Continued from page 176)

these days. Respondents reported getting an average of 19.4 mpg in town and 25.3 on the highway. This compares with EPA ratings of 21/29 mpg for the V6 with automatic. At the time of our survey, the optional five-liter V8 and the four-cylinder 2.3 Turbo Coupe hadn't yet become available, so all our

respondents ran the standard 3.8-liter V6 with overdrive automatic.

Performance with the V6 pleased nearly all owners, although a few felt it could use a touch more power for steep grades. Many praised the automatic's smooth shifts and its contribution to fuel mileage. But we did hear a little grumbling about this transmission's refusal to kick down at higher cruising speeds (60 mph and above).

When we asked for recommendations to improve the Thunderbird, most owners passed, but we did receive this gem from an Iowa heavy-equipment operator: "Let's push Ford to introduce a Thunderbird convertible. Can you imagine how great *that* would look? The T-Bird already looks like a cross between a Mercedes and a Jaguar coupe, so as a convertible it ought to be absolutely fantastic." **PM**

SUMMARY OF 1983 THUNDERBIRD OWNERS REPORTS*

Total miles driven	637,964	Location of horn	4.7	Comfort opinion (rear seats):		Poor	7.2
		Not enough power	4.0	Excellent	62.3%		
Average miles per gallon:**				Good	32.5	Number of vehicles owned:	
In town	19.4	What changes would you like?		Fair	4.6	This car only	45.2%
On the highway	25.3	No changes	22.2%	Poor	0.7	Two cars	45.8
Why did you choose this car?		Reposition spare tire	13.7	Had any mechanical trouble?		Three cars	4.8
Styling	77.5%	Move horn to wheel	6.8	No	72.2%	Four or more cars	4.2
Past experience	17.5			Yes	27.8	Makes of other cars owned:	
Handling	13.8	How much did you pay?				Ford	49.5%
Comfort	10.6	Average	\$12,256	What type of trouble?		Chevrolet	14.3
Ride	10.6	Range	\$9,800-\$16,200	Transmission	11.1%	Toyota	6.6
Specific likes:		Workmanship opinion:		Fuel induction system	11.1	Age distribution of owners:	
Styling	61.3%	Excellent	61.2%	Cruise control	8.9	15-29 years	8.2%
Handling	54.2	Good	33.9	Electrical	8.9	30-49 years	45.0
Economy	36.1	Average	4.2	Air conditioner	8.9	50-plus	46.8
Comfort	36.1	Poor	0.6	Dealer repairs satisfactory?		Would you buy another T-Bird?	
Riding qualities	35.5	Comfort opinion (front seats):		Yes	74.4%	Yes	94.0%
Specific dislikes:		Excellent	72.7%	No	25.6	No	6.0
No complaints	44.0%	Good	24.8	Dealer service opinion:		Would you buy another Ford?	
Position of spare tire	6.0	Average	2.4	Excellent	42.3%	Yes	95.3%
Noise and rattles	4.7	Poor	0.0	Good	43.2	No	4.7
				Average	7.2		

*Percentages might not equal 100% due to rounding or insufficient data.

**Figures are for the V6 engine with overdrive automatic, the only power train available when the Thunderbird was introduced.

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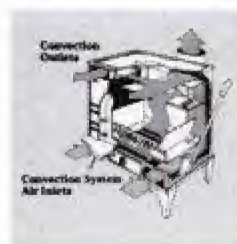
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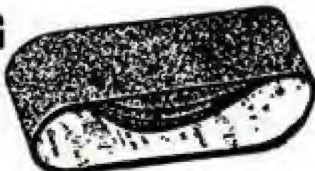
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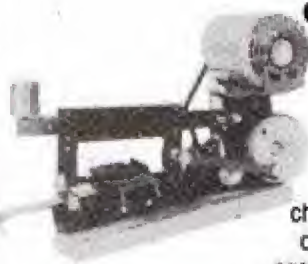
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My wife and I discussed the project as we were driving home. We decided to try it.

The project kept us busy about 8-9 hours each week. We used our dining room as an office and kept supplies in one corner of our hall closet.

At first our income was small — \$75 to \$95 per week. But, as the months passed, we began making over \$700 A WEEK — all at home.

Let me emphasize one thing. This is very important. Our "money project" is moral, honest and downright enjoyable. And, it's 100% your own. It doesn't involve working for anyone else.

I explained the project to my mother in Akron, Ohio. She was 71 years old and lived by herself in an apartment on West Market Street. Within the first 90 days she made over \$3,000. All by herself!

As our curiosity grew, we discovered a variety of other people making money but with somewhat different projects...

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Two New Jersey housewives I spoke with started a similar project two years ago. Both of them have young children at home and households to run — in addition to their home-based business. Currently, their part-time project is bringing in over \$35,000 a year.

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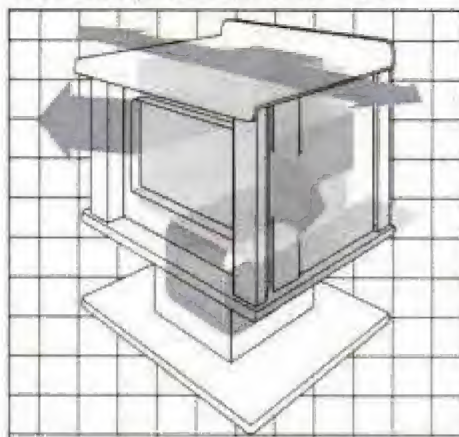


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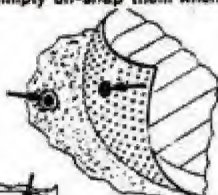
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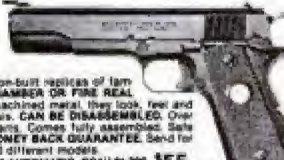


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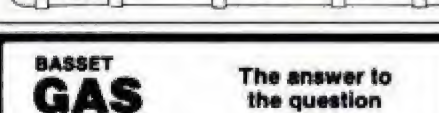
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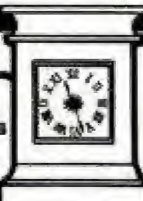
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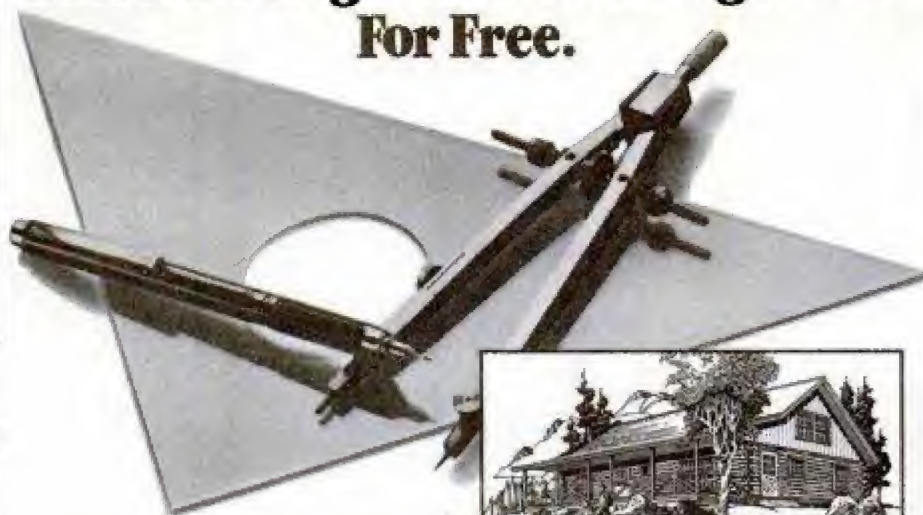


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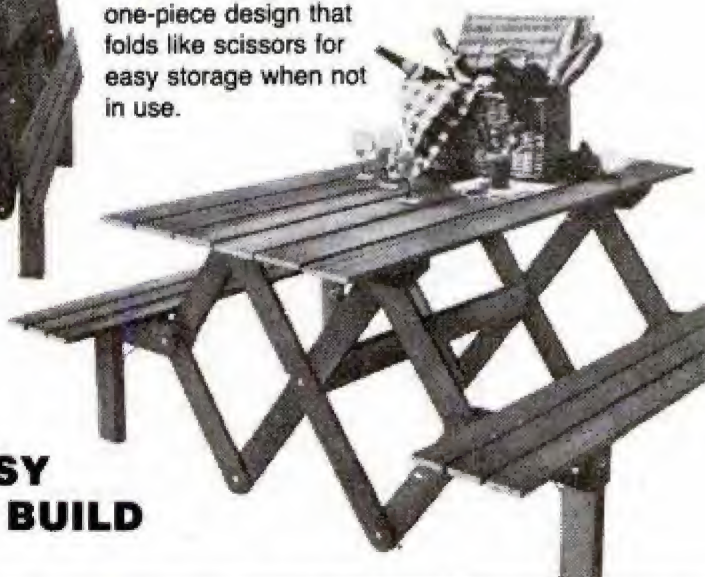


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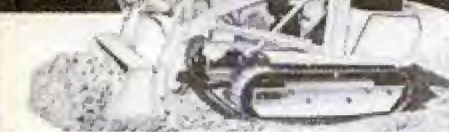
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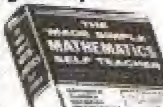
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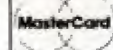
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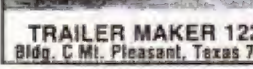
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FREE BEERMaking BOOK Plus Catalog. Finest Equipment, Ingredients. Fully Guaranteed. SPI, Box 784-M, Chapel Hill, NC 27514

WINEMAKERS-Beermakers: Free illustrated catalog of supplies. Samples. Box 12276R, Minneapolis, Minnesota 55412-0276

FREE ENCYCLOPEDIA Winemaking, Beermaking Supplies, Equipment, Ingredients. Vynox, P.O. Box PM15498, Rochester, NY 14615

MAKE BEER - No kits. Easy and Cheap, 12c/16oz. Directions using grocery store ingredients. \$2.00. L. Story, P.O. Box 17141, Greenville, S.C. 29606.

MAKING Whiskey, Gin, Vodka, Alcohol. Illustrated Manual, \$2.00. Homebrewer, 723 Disston, Philadelphia, PA 19111

BARTENDERS MAKE BIG MONEY You Can Learn To Be A Bartender At Home 50 Of The Newest And Most Popular Drink Recipes Includes FREE Kahula Recipe, Send \$3.00. To: P.O. Box 1377, West Hartford, Conn 06107

BEERMakers ONLY! Free Catalog/Newsletter. William's, Box 461M, Oakland, California 94604.

MAKE QUALITY BEER, Wine. Free catalog. Village Store, Box C-51PM, Westport, MA 02790

LIQUOR RECIPES, Kahula, Amaretto. Others. Bottling instructions included. Nice Gifts. \$2.00. Victor's of California, 637 Cabrillo Ave., Santa Cruz, Calif. 95065

"HOW To Make Moonshine" 45 pages available \$2.30. B&J Enterprises, 1845 S. 19th, Springfield, Ill. 62703

FREE BEERMaking CATALOG. Lowest Prices. Homebrew, Box 158M, Haslett, Michigan 48840

BURGLAR ALARMS & HOME PROTECTION

BURGLAR-FIRE ALARMS for home, business, auto. Install yourself and save. Installation manual/catalog shows how. Shows latest equipment, accessories. Lowest prices. Send \$1.00 (refundable). **BURDEX SECURITY**, Box 82802-PMI, Lincoln, NE 68501

ALARM Personal And Home Alarm Including Flash Light Shirt Pocket Size Loud Piercing Sound \$4.95, P&H \$1.50. Phillips, P.O. Box 2683, Zanesville, Ohio 43701

"DOOR OR WINDOW ALARMS \$6.95. Chain Door Lock Alarm \$8.95. Plus \$1.25 Postage Each. Direct Wholesale, P. O. Box 67, Chicago, Illinois 60617

To Celebrate Our 10 Millionth Sale!

Quartz Watches

Only \$2

With This Ad

This is *NOT* a misprint.

This special offer is being made to celebrate the 10 millionth watch sale of the famous New York jewelry firm of Abernathy & Closther. It is open to every person who mails this original printed ad to the company address (below) before December 25, 1983.

To celebrate its 10 millionth watch sale, the prestigious New York jewelry firm of Abernathy & Closther will distribute one million famous LCD Quartz Calendar Watches for only \$2 apiece to the first one million people who mail this printed ad to the company address before Midnight, Dec. 25, 1983.

These are the same famous LCD Quartz Calendar Watches to be demonstrated on national TV and advertised in *The New York Times* and other leading publications.

A true calendar watch, it displays the hour, minute and second—as well as the month and day—in full quartz digital mode. Its built-in quartz computer is so powerful it never needs winding and is accurate to within seconds per month.

These famous LCD Quartz Calendar Watches will not be sold at this price by the company in any store.

NOTE: This *original printed ad* must accompany your request. Copies or photostats are not acceptable.

To obtain one at this price, mail *this original printed ad* to the company address below no later than Midnight, Dec. 25, 1983.

Each watch carries a full money-back guarantee and will be replaced by the company, free of charge, if it ever fails to function.

There is a limit of 2 watches per address at this price, but requests which are mailed early enough (before Dec. 17) are permitted to request up to 5 watches.

To obtain your watch, mail *this original printed ad*, together with your name and address and \$2 for each watch. Add only \$2 shipping and handling no matter how many watches you are requesting. Specify Men's (Item #A22451) or Ladies' (Item #A22452). Mail to: **Abernathy & Closther, \$2 Watch Offer, Dept. 114-9, Box 1736, Hicksville, New York 11802. (A22450)**

NUMBER ONE AND STILL CLIMBING!



TOUGH FORD FULL-SIZE 4x4

Ford toughness and innovation drove our F-Series 4-wheelers to the top. Now two trim sizes join America's best-selling* full-size 4x4 pickup—Bronco II and Ranger.

*Based on registration data for 1983 model year through December, 1982.



NEW FORD BRONCO II

The perfect size for 4-wheeling! Turns in less space than Chevy S-10 Blazer, seats 4 in comfort. V-6 engine is *standard*, with power S-10 can't match... the power you need for 4-wheeling fun!



FORD RANGER 4x4

The best-selling† American 4-cylinder pickup now offers the most powerful V-6, too! Beats Chevy S-10 in horsepower, torque. It's OFF-ROAD Magazine's "4x4 Truck of the Year!"

†Based on calendar year registrations through December, 1982.

Get it together—Buckle up!

AMERICA'S TRUCK

**BUILT
FORD
TOUGH**

CAMEL

LIGHTS



9 mg.
tar.

Camel Lights.
Low tar. Camel taste.

9 mg. "tar", 0.8 mg. nicotine av. per cigarette by FTC method.

Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.